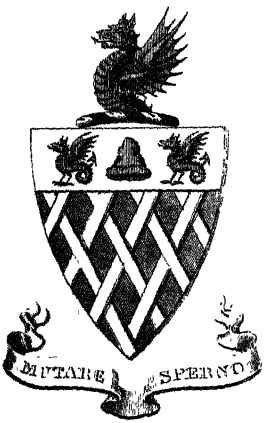
MVTARE SPERNO

BULLETIN

OF THE

BOTANICAL DEPARTMENT, JAMAICA.

EDITED BY

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Director of Public Gardens and Plantations.

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JAMAICA.

BULLETIN

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BOTANICAL DEPARTMENT.

New Series.] JANUARY, 1901. Vol. VIII Part I.

BASTARD LOGWOOD.

Messrs. George & Branday to Director of Public Gardens.

DEAR SIR,

Can you tell us the reason that green Logwood cut crosswise with a saw turns pale? We are told from the United States that this is Bastard Wood, in face of the fact that we have seen the same wood cut both with an axe and saw exhibit different aspects.

We need not tell you that with all wood so cut a claim is made and an allowance obtained.

We ask you to give publicity to this letter and your reply in order to warn the public against this imposition.

We find by wetting the ends so cut the dye comes out and no claim is made on such cargoes, but this is not always practicable.

REPORT BY DR. DUERDEN.

In reply to a request for samples of the logwood exhibiting the characteristics referred to in Messrs. George & Branday's letter, several specimens of what is understood as bastard logwood were received at the Museum, and also specimens of ordinary logwood for comparison. The differences between the two are most striking, and there should be no danger of mistaking the one for the other. The so called bastard logwood is rather yellowish in colour, somewhat recalling cashaw wood, and however long it is exposed to atmospheric influences, never becomes so darkly stained as the dye-containing logwood. A newly exposed surface of the bastard wood also emits a strong odour, which is not so marked in the true wood. On immersing chips of the bastard wood in water, scarcely any colouration is produced even within two or three days, while in almost as many minutes the dye-bearing logwood colours the water strongly.

On sawing crosswise the true logwood the fresh surface produced is certainly much lighter in colour than a surface which has been exposed for some length of time, and may then perhaps be confused with the bastard wood by anyone anxious to do so. But the general surface of the block would be enough to show the absurdity of this, and in wetting the fresh surface, even to a very slight degree, the contained dye soon becomes apparent.

A fresh surface produced by the cut from an axe is of a different character from that produced by a saw. In the former the constituent wood fibres are cut more longitudinally than transversely, and do not display rugged edges, and hence, in general, are darker coloured.

I see no reason whatever why, as Messrs. George & Branday assert, true logwood should be denounced as bastard logwood solely from the appearance of the freshly sawn ends. It is reasonable to suppose that the character of the block as a whole would be taken into account; if this be not so, then it seems advisable before offering for sale to have the fresh surfaces exposed for some time to atmospheric influence in order to darken them.

I find that all the planters I have consulted upon the matter are acquainted with the fact that bastard logwood trees occur in a greater or less proportion on their properties, but that the cutters can detect them after the first stroke or two, after which they go no further with the tree. The presence of many blocks of bastard logwood would seriously lower the value of any shipment. It is noticed, however, that there are certain degrees in the occurrence or absence of the dye.

From the date before me I have not been able to determine the cultural conditions which give rise to the bastard wood Apparently the trees while alive are indistinguishable from those bearing the dye. The practical absence of the dye seems a matter well worthy of further investigation in the field, for apparently every property possesses a greater or less percentage of the so-called bastard trees.

Note by Director of Public Gardens and Plantations.

I have found no differences in leaves and flowers between common logwood and the "bastard" kind. They are not botanical varieties, but the bastard wood may be a degenerate form. I do not think that soil makes any difference. The subject of inferior wood was discussed in Bulletin for August, 1896, page 179, a copy of which will be forwarded on application.

NOTES ON IRRIGATION.

Recent Progress in the Study of Irrigation.

According to Newell, "the area irrrigated within the arid and subhumid regions in the western part of the United States during the census year ending May 31, 1890, aggregated 3,631,381 acres or 5,674.03 square miles, approximately 0.4 per cent. of the total area west of the one hundredth meridian." The arid region where irrigation is an absolute necessity for successful agriculture embraces in part or in whole the following States and Territories: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. The subhumid region where as a rule insufficient rain falls for full crops includes parts of North Dakota, South Dakota, Nebraska, Kansas, and Texas. A large proportion of the irrigable area in these vast regions still remains to be irrigated.

The necessity for irrigation, moreover, is beginning to be felt in the so-called humid regions east of the one hundredth meridian, and within comparatively recent years widespread interest has been manifested in the subject of irrigation in this region. In recent years widespread

drought, especially at critical periods in the life of certain crops, has drawn the attention of Eastern farmers and horticulturists to this subject. Truck farmers and fruit growers, especially in region accessible to good markets, are beginning to appreciate the importance of irrigation.

King has found that even in favourable seasons in Wisconsin, which is in the so-called humid region, the rainfall does not supply sufficient moisture to produce maximum crops. During the season of 1896, in which the rainfall was normal in that State, a variety of crops was irrigated with profit, notwithstanding the fact that the irrigation plant employed was not used to its full capacity and thus the cost of irrigating was higher than it need be. The profit from irrigation was on corn, $2.16 per acre; potatoes, $11.70; clover hay (irrigating second crop only), $1.72; cabbages, planted thin, $2.43, planted thick, $29. "The great lesson," says King, "to be learned from these results is that we must have an abundance of water in order that our crops may avail themselves of the plant food stored in our soils, not that water is everything, but the fertility of the soil counts for naught without it."

The above statements give us some idea of the great and increasing importance of irrigation to the American farmer. Recent investigations on this important subject have given some results of considerable practical value, and it is the purpose of this article to briefly summarize these results.

The greatest profit is derived from irrigation where intensive farming is practised. In fact, the practice of irrigation naturally leads to intensive farming. In such farming the aim should be to economise all the elements of fertility, to utilize water, fertilizer, labour, etc., to the best possible advantage. If fertilizers are used they will give the best returns if kept in the upper layers of the soil, where they can be fully utilized by the plant. If irrigation is practised also, the amount of water applied should not be excessive, otherwise the fertilizing materials are either washed into the lower layers of the soil where they can not be utilized by the plant or are entirely removed in the drainage.

Edmond Gain, a French authority, has shown that the water requirements of plants differ widely at different stages of growth. His observations show that it would be very injurious to the plant, even if it were possible, to maintain a uniform state of moisture in the soil. He observed, for instance, that for the ordinary farm crops the optimum, or most favorable amounts, of moisture in the soil at different stages of growth, were about as follows: At the time of planting the soil should have about 25 per cent. of the total amount of water which it is capable of holding. then it should fall to 15 per cent. and remain at this point until the first leaves are formed, when it should be raised quickly to nearly 40 per cent. It should be allowed to fall rapidly to about 25 per cent. and remain at this point until shortly before flowering, when it may be raised gradually to 40 per cent. and then allowed to fall rapidly to 12 or 15 per cent., where it remains during fruiting and maturity. Briefly, then, the soil should be only moderately moist at time of planting and comparatively dry thereafter until the first leaves are formed, when it should be thoroughly irrigated. It should then be allowed to become comparatively dry and remain so until the flowering stage,

when it should have its most liberal irrigation, After this it should be allowed to become dry during fruiting and maturity. Of course this represents ideal conditions which can not be completely secured in practice, but it suggests how irrigation water may be greetly economized at the same time that the most favourable conditions of growth are secured for the crop.

This alternation of dry and wet pericds has another important point in its favour on ordinary soils. Hilgard has shown that it furnishes the ideal conditions under which the soluble constituents of the soil rise to the surface. The evaporating water leaves the matter which it holds in solution at the place where it evaporates, i.e., at the surface of the soil. It thus keeps the valuable fertilizing constituents of the soil within easy reach of the crop. On "alkali" soils, however, under the above conditions the corrosive poisonous alkaline salts would accumlate at the surface to the destructlon or great injury of the crop.

Methods of applying irrigation water, especially surface irrigation and subirrigation, have been tested by a number of the experiment stations in both arid and humid regions. The results have generally been unfavourable to subirrigation. The laying of the underground pipes necessary in this system is of course expensive, and, moreover, it is difficult, if not impossible, in subirrigation to obtain a uniform distribution of the water throughout the soil on account of the fact that while water moves up and down in the soil with comparative rapidity it moves from side to side very slowly. The irrigation pipes being out of sight it is impossible to note the movement of the water with accuracy. The soil immediately surrounding the pipes may become excessively wet, while a large proportion of the soil between the pipes is insufficiently irrigated. Moreover a considerable amount of the water may pass down into the lower layers of the soil without being of the slightest benefit to the crop. King found that a given amount of water was much more effective in increasing the yield of corn when applied by surface irrigation than when applied by subirrigation.

Rane, of the New Hampshire Experiment Station, in experiments with celery on clay loam soil "with water applied both through ditches for surface irrigation and through tiles below the reach of the plough for subirrigation" found that "the latter system required much more water than the former for the same results."

[A method of tile irrigation which he has found to possess decided advantage[8] over ordinary subirrigation] was to place common porous 2½ inch drain tiles in a continuous row, end to end, on the surface of the soil, vegetables being planted on either or both sides of the line. The tiles were 1 foot long, and by pouring in the water at one end of the line it was distributed at the joints throughout the length desired when the opposite end was stopped up. Take celery as an example crop for irrigation on uplands. We plant the celery as above stated, and while it is young we have simple surface irrigation; but as the crop grows we bank it up, and finally have the tiles covered, and thus have subirrigation. The tiles are cheap and last indefinitely. When the celery is harvested, the tiles are dug out also and piled up or used for subirrigation in the greenhouse beds. Potatoes and various other crops can be grown in the same way. The celery watered this year grew well and did not rust. Besides this, we were able to water twenty times as much space in the same time as in the ordinary way with ditches. Besides saving time, this plan delivers water where it is most needed, and we have reason to believe is fully as economical with water as with time.

Experiments during two seasons have shown that with this method

"the plants did fully as well as in the other systems and with less water."

Where irrigating is to be done on a large scale, it seems to be the concensus of opinion that surface irrigation by means of furrows is undoubtedly the most practical method. In greenhouses and gardens subirrigation by means of tiles may often be found advisable. Furthermore, many soils need drainage and require the laying of tile. On such soil it may be possible to combine drainage and subirrigation economically, and the Wisconsin Experiment Station is at present studying this subject.

A question of the greatest importance in regions of deficient rainfall or where irrigation is practised is the storage capacity of the soil for water. When the soil is thoroughly loosened up, the amount of water which it will hold is greatly increased, and the rise of water to the surface and evaporation are checked. Experiments at the Wisconsin and Nebraska Experiment stations have shown the beneficial effects in these respects of subsoiling. On this point the Nebraska station makes the following suggestions:

Subsoil ploughing, although a means of conserving moisture, does not produce it, and is, therefore, not a substitute for irrigation where the rainfall is too small to produce crops.

Where there is a hard, dry subsoil, subsoil ploughing is to be recommended.

Where the subsoil is loose, gravelly, or sandy, subsoiling is probably unnecessary, or may even be injurious.

Do not subsoil when the soil is very wet, either above or beneath, as there is great danger of puddling the soil, thus leaving it in worse condition than before. This is one of the reasons why it is better to subsoil in the fall than in the spring.

If the ground be subsoiled in the fall, the winter and spring rains have ample opportunity to soak in, that being the season of greatest rainfall and least evaporation.

Subsoiling in the spring may be a positive detriment if the subsoil be extremely dry, as in that case the rain water is partially removed from the young plant by the absorption of the bottom soil. If the spring rains were heavy, this would not be a disadvantage.

It is probable that the increased yields on subsoiled lands are mainly, if not entirely due to the increased amount of water which such land is able to store up for the use of the crop. Subsoil ploughing may thus be made the means of greatly extending the area over which crops may be successfully grown without irrigation, and when practised in connection with irrigation may result in a great saving of irrigation water. As indicated above, however, before deciding upon the advisability of subsoiling it is necessary to ascertain, among other things, the nature and condition of the soil and subsoil. (*U. S. Dept. of Agri., Farmers Bulletin No. 56*)

Irrigation in India.

For many years it has been well known in India that irrigation should not be allowed in places where the soil is much impregnated with salts or where the subsoil drainage is defective. So long ago as 1862, General Strachey of the Royal Engineers, lucidly stated the case as follows:—

The salts known as "reh" are contained in the soil. If canal percolation takes place, it may at length proceed to such an extent as to saturate the subsoil with water. The surface being at the same time exposed to sun and air, becomes heated, and continual evaporation goes

on. The water lost by the surface evaporation is replaced by moisture drawn up from below by capillary action. The water coming from below contains a certain quantity of the soluble salts of the soil which it has taken up on its way: as the water evaporates at the surface the salts must be left behind, and a constant accumulation of the salt takes place on the evaporating surface. Where such efflorescence takes place at a distance from a canal, and where no free percolation takes place it may possibly be explained by the action of an impervious stratum of clay (or kunkur) at some depth below the surface, which arrests the descent of water derived from the fall of rain (or irrigation), and accumulated from a large area into some natural depression, and held as it were, in a basin, though of course diffused in the subsoil from which the great summer heats at length extract the whole of it with the same result as before suggested.—*From "The Progress and Position of Irrigation in New South Wales," by H. G. McKinney.*

HEALTH AND IRRIGATION.

The notion that irrigated rice fields are unhealthy has led to the abandonment of rice-growing in France and Portugal. But it is only when the layer of water is exceptionally shallow or discontinuous as well as stagnant, that bad effects on the health of the district have followed. It is at the close of the growing season, when during very hot weather the water no longer covers the soil, and also in the case of badly-planned and badly-managed rice fields, that there is danger from the rapid decomposition of organic matters in the earth.—(*Encyclopædia Britannica.*)

DISEASED LEMON TREES.

From Professor Dr. D. T. MacDougal to Director of Public Gardens.

New York Botanical Garden, Bronx Park,
New York City.

Dear Mr. Fawcett,

Your letter with the diseased specimen of lemon tree came duly to hand. I have submitted the specimen to Professor Underwood, and several of his men, and none of them can tell me anything about it. As a last resource I sent it over to Washington to be examined by Mr. Webber who knows more about the diseases of the citrus trees than any one else in the country. His letter is enclosed herewith, and you will see that it has not appeared in this country sufficiently toen able him to find out anything about it.

Our failure to give you anything definite about the various diseased specimens you have sent me from time to time, impresses me with the necessity of having some one actually on the gronnd to work on your plants, and I wish very much we could co-operate in getting a mycologist to work over Jamaica for a season or two. I have no definite proposition to make, however, as our exploration fund has already been planned for the present year.

Meanwhile I hope you will continue to send us anything you wish examined, and we will do our best. Jamaica seems to have a series of plant ailments quite different from those of Florida.

D. T. MacDougal.

From Prof. H. J. Webber to Prof. D. T. MacDougal.

U. S. Department of Agriculture,
Division of Vegetable Physiology and Pathology.

Dear Doctor MacDougal:

Mr. Galloway has handed me your letter of April 7, and the accompanying specimens of diseased lemon twigs from Jamaica. This "lemon tumour," as it is called in Florida, is not a very common disease. I think I have seen it twice in different parts of Florida. It never caused sufficient damage, however, to justify an investigation, so that we are not certain as to its cause. By cutting the tissue one finds that the cells and intercellular spaces are filled with a colourless mycelium which seems to become blackened at the surface similar to *Cladosporium* or *Macrosporium*. I do not recall, however, to have ever found any fertile specimens, and the specimens which you enclose seem to be sterile. The disease cannot be said to cause any noticeable damage and the result is that we have paid no attention to it.

H. J. Webber,
In charge of Plant-Breeding Laboratory.

DATE PALMS.*

The number of date palms in the Vilayet of Tripoli, North Africa, is computed at 2,000 000, and is the most important of all trees, all its component parts serving usefully in some way or another; the fruit for food, the leaves for mats and hut coverings, the wood for building and uel, the fibre for baskets and ropes, the juice for drinking, and finally the stones made into a paste are given as food to animals. A certain quantity of date-stones is exported to Italy to adulterate coffee.

Date paste also forms an article of export to Egypt and Turkey.

The date enters largely into the food of the people, especially during poor cereal harvests, when its price is governed by that of barley. The tribes of the Fezzan consume large quantities of the Tripoli dates as their principal food, and every autumn caravans arrive from the interior, especially at Misurata, for the purposes of purchase. Animals are fed on them in the oases of the interior. A large consumption of lagbi or palm wine, the juice of the tree, takes place in the country among all classes, religious prejudices not applying to it as an intoxicant; the season is from May to October. An incision is made near the top of the tree and the sap allowed to flow into an earthenware jar which is attached and changed twice a day. The flow continues nearly three months, but not always in the same quantity. A good tree produces lagbi to the value of 2s. to 2s. 6d. a day, but its extraction causes it to produce no fruit for the next two or three years The consumption, however, is great, and little labour is required. The total annual value is about £3,200, the tax being 20s. per tree excised.

*Mr. Consul-General Jago, in Foreign Office Report on Tripoli, June 1900.

When taken fresh from the tree it resembles milk and has a sweet taste, but later on becomes sour. A small quantity of spirit called "bokha" is distilled from the date, and is consumed locally. It is an intoxicant and somewhat resembles arrack. Efforts to export dates to Europe for distilling purposes have failed, owing to heavy import duties. The export of dates to Bengazi, Egypt and Turkey varies between £700, and £2,000, according to good or bad seasons, and chiefly from Zleiten, Misurata and Tuarga. Plantations are rare, except in those parts which are exempt from taxation.

SUNFLOWER SEEDS.

(*From the Annual Report of the British Consul-General at Odessa, Russia.*)

There is a growing demand in Russia for oil-yielding seeds, particularly for those of the sunflower. Until recently there have been but few mills for expressing this oil,and the growers, finding no market at home, sent their seed abroad. Now, however, there are mills in Russia which require large quantities of it, and what is more. they offer the growers higher prices than those obtainable abroad. With the increasing home demand, a falling-off in the export of oil seeds may be looked for in the near future. Samples of sunflower seeds were recently asked for by the Government of Bengal, where it is intended to try them. From personal experience I know that the plant will grow very luxuriantly in East Africa. It may well be found a suitable crop for other British colonies. In this country it is found that the best results in sunflower cultivation are obtained from a well tilled soil, with not too much clay in its composition; it should be well ploughed in the autumn and harrowed in the spring. The seed should be sown in April or May in every second or third furrow. One or sometimes two or three seeds should be put into the ground at a distance of two to four inches apart. Broadcast sowing may also be resorted to, care being taken that only one seed falls in every two square feet. The quantity of seed required per acre is 20 lbs.; the yield, if good, should be about 1,600 lbs. The yield in oil of seed in husks is 17 per cent., without husks, 20 per cent. It may be of interest to add that the seed is much liked as a light refreshment by the poorer Russians; indeed it is sold in the streets by hawkers to be eaten as nuts are eaten in England.

OIL OF EUCALYPTUS.*

Oil of Eucalyptus is obtained by distillation from the fresh leaves of *Eucalyptus Globulus*, Labill, and other species of *Eucalyptus*. The *E. Globulus* is the ordinary "blue gum" tree, indigenous to Victoria and Tasmania, and cultivated in Italy, Spain, the south of France, etc.; it attains a height of 300 to 350 feet, has a smooth ash coloured bark, leaves up to 12 inches in length, large pinkish-white axillary flowers

* Pharmaceutical Journal, Sept. 8th, 1900.

which may be solitary or in clusters, and a four-sided capsular fruit, which is closely enveloped in a hard woody calyx-tube. On young plants the leaves are opposite, ovate, cordate at the base, sessile, and their surfaces are parallel with the ground; but in the case of older plants, and especially at the upper parts of the trees, the leaves are longer, stalked, and scimitar-shaped, whilst a twist in the petiole causes the surfaces to be at right angles to the ground. Both forms are used in distilling the oil, but the dried leaves are of the second form only; they are thick, glabrous, leathery, with an entire, somewhat thickened margin. The presence of numerous oil glands, situated in the mesophyll and easily seen on examining a leaf with a lens whilst held up to a strong light, gives the leaves a distinctly punctate appearance; the surfaces are also frequently marked with a number of minute, warty, brown spots, which consist of groups of cork cells. The leaves contain when fresh, from 3 to 5 per cent. of volatile oil, together with tannin and a bitter principle. The oil is obtained from the fresh leaves by distillation and possesses powerful antiseptic, deodorising and antipyretic properties, the official dose is from 0·5 to 3 minims, and the oil is used in the preparation of Unguentum Eucalypti.

Characters and Tests—Oil of Eucalyptus (s.g. 0·910 to 0·930) should be colourless or pale yellow, with an aromatic camphoraceous odour, and a pungent taste which is followed by a sensation of coldness in the mouth; the characteristic taste and odour are due to the cineol (eucalyptol) present, and a high percentage of that body is insured by the limitation of the specific gravity of the oil, as also by the optical activity of the oil being limited to 10 degrees in either direction. The presence of a due proportion of cineol is further provided by the requirement that the oil should become semi-solid on being stirred, when cold, with one-third or one-half its volume of phosphoric acid (s.g. 1·750); the cineol combines with the acid to form a crystalline compound from which it is liberated in the pure state on adding hot water. The nitric reaction serves to guard against the presence of more than small quantities of phellandrene, which constitutes the chief constituent of certain Eucalyptus oils; thus, if to 1 c.c. of an oil containing but little phellandrene, 2 c.c. of glacial acetic acid, and 2 c.c. of a saturated aqueous solution of sodium nitrate be added, the mixture will remain liquid when gently stirred, but the presence of much phellandrene will cause the formation of a crystalline mass. The oil is soluble in all proportions of absolute alcohol, in one third its volume of 90 per cent. alcohol and in 38 parts of 60 per cent. alcohol.

Notes.—The distinctive characters of oil of Eucalyptus are its odour, taste and specific gravity. It contains about 50 per cent. of cineol (eucalyptol), a body which also occurs in the oils of cajaput, wormseed, spike lavender etc., and can be produced by treating terpin hydrate with dilute acids. Cineol is an optically inactive, nearly colourless liquid (s.g. 0·930) with a strong, aromatic, camphoraceous odour, and a pungent, spicy, and cooling taste; it has a refractive index of 1·4559, solidifies at low temperatures, melts at —1°, boils at 176° and forms a crystalline phosphate when treated with phosphoric acid. Other constituents of oil of Eucalyptus are pinene and various aldehydes and alcohols. Phellandrene should not be present in any appreciable quantity, the oil of *E. amygdalina* and other species being thus excluded.

SELECTIONS FROM ANNUAL REPORT OF DIRECTOR OF PUBLIC GARDENS, &c., FOR THE YEAR ENDED 31st MARCH, 1900.

The Superintendent of Hope Gardens reports results of experiments in budding on various stocks in continuation of his report of last year :—

Sweet orange on lime stocks—These trees continue to grow well. They fruit regularly, and are perfectly free from scale insects and all forms of disease. Th y receive no attention in the way of cultivation, except that, being in the nursery, they never suffer from drought.

Sweet orange on rough lemon stocks still look well.

Sweet orange on sour stocks also look well.

Sweet orange on sweet stock –Of the 18 trees originally planted out at Hope, three only have been allowed to live ; these are looking well. The other 15 showed signs of various diseases and were destroyed. Sweet orange is a bad stock at Hope. This is an important fact to notice, as at one time many people were trying to persuade owners of properties to cut down what they call their " wild" trees and have them budded. In many cases the so-called " wild" trees produced delicious fruit, and to cut down such trees for the sake of budding them with varieties known by name only would be absurd.

Navel oranges have done equally well on sour stocks and rough lemons.

Tangierines also look well on both stocks.

Grape fruit on rough lemons are looking very well.

Shaddocks also are doing well.

It m y prove interesting to record here the growth made by different citrus fruits on different stocks. The figures quoted below are for trees budded at Hope in July and August, 1896, on stocks not more than one year old, and transplanted to the places they now occupy in September. 1897 :—

	Height.	Circumference.
Grape Fruit on rough lemon stock	12ft.	13ft.
Shaddock	10ft.	12ft.
Lemon Imperial	10ft.	13ft.
Sweet Orange on Sweet Orange Stocks	8ft. 6in.	9ft.
" " Rough Lemon "	7ft 6in	13ft.
" " Sour Orange*	8ft.	6ft.
Tangierine Rough Lemon "	10ft.	8ft.
Navel " " " "	10ft.	10ft

Budding.— Our experience of budding in Jamaica has taught us that a strong stock growing rapidly, a healthy fresh bud, and a sharp knife are absolutely indispensable With these 95 per cent. of buds put in ought to grow. Without these 95 per cent. will fail. If the stock receives a check after the bud is put in, the bud will suffer, and probably die. Fine dry weather and artificial watering are the best at Hope for budding. One constant rule is, if the sap of a st ck is not flowing sufficiently to allow the bud to lift the bark without help from the knife or finger, that stock is not budded, but left until the bark does *run* easily.

* These are a year younger than the others.

Diseases—Scale insects are easily destroyed by the mixture of soap and kerosine recomended in the Bulletin for December, 1898. Gumming is prevented almost entirely by liming the soil. Beetles eat the leaves, causing much damage; the remedy is to catch and kill them, or if too numerous, to spray with Paris green mixed with water.

Cocoa.

A chemist who has studied Cocoa in the various W. India Islands where it is grown, states that he has formed the opinion that not much dependence can be placed on the form of the pod in making choice of good seed. One seed in the pod should be cut, and the colour noted. This, he thinks, is a more reliable test than the form of the pod. For flavour he prefers the white colour in the interior of the seed. But if this kind of cocoa is produced by a tree not so vigourous as that yielding seeds with red or purple colour, at any rate the light pink colour is preferable to the purple colours.

He is of the opinion that small settlers should go in for a quick fermentation of about 4 days in shallow boxes.

In March 1899, 60 young plants were planted out at Hope, some of these on good loamy soil with irrigation have reached a height of from 3 to 7 feet, those on thin dry gravelly soil deficient in humus have grown but little. Cocoa needs good moist soil and some shade when young. Old cocoa trees need similar root conditions, but not shade. All cocoa trees require protection from wind.

It is necessary to plant young trees each year in order that the boys may be instructed in the act of planting, pruning and caring the young trees.

Coffee.

Mr. Robt. Thomson in a letter to the "Times" during last year quotes paragraphs from his paper published in a Foreign Office Report in 1895 (Misc. Ser. 370 Colombia.)

He states in his report that coffee cultivation in Colombia yields a larger profit than in Jamaica.

He assigns several causes, viz; land at a nominal cost, cheap and abundant labour, exchange in planters' favour, and larger yield per acre.

All these causes are more than sufficient to account for a large profit. He might have added abundance of land with virgin soil and suitable climate, which would fully account for the larger yield. He, however, appears to think that "one of the chief elements of success must be assigned to the systematic interplanting of shade trees with the coffee," and apparently assumes that this is not the practice in Jamaica.

Elsewhere he alleged that another reason for the low price of Jamaica coffee is the want of careful preparation.

I understand, although he does not make it clear, that he is only referring to the coffee of the peasantry. It is however hardly fair to compare without discrimination the coffee industry in the two countries: in Colombia it is carried on by capitalists on large estates, whereas in Jamaica the bulk of the coffee is grow by peasants on small holdings.

Mr. Thompson refers to extension of cultivation. In my Annual Report for 1892-93 I dealt with the desirability of the extension of

cultivation chiefly by large landowners, and pointed out that the circumstances operating against any increase in cultivation were scarcity of labour and want of roads which also enhance the cost of production and putting on the market.

At the present time and with the price of coffee so low, it is rather the improvement in cultivation and in the curing of coffee of low altitudes than any extension that is desirable.

Mr. Thomson states that in Colombia at an elevation between 5,000 and 6,000 feet, no shade at all, or only light shade, is required; and between 3,000 and 5,000 feet he recommends certain leguminous trees, Erythrina and Inga. He is in error in stating that "British colonial coffee planters have in the main ignored the application of shade to the coffee." In Jamaica as well as in Colombia the coffee tree at highest elevations does not need any shade, but on the contrary it wants all the sun it can get; and if for some reason, sush as the proximity of forest land inducing cloud, there is a deficiency of direct sunlight, the coffee berries do not ripen, and cultivation is a failure At somewhat lower altitudes a slight shade is necessary, at any rate during the hottest part of the year. Jamaiea coffee planters in the Blue Mountains use the West Indian Cedar which is a light shade at a good height above the coffee, the trees being bare of leaves during the winter months. In Manchester at still lower elevations the light shade of the Trumpet tree is made use of, and shade of some kind is quite universal at this and all lower elevations. In fact so far from shade not being used, I have frequently pointed out cases where the shade used is too dense, favouring the growth of fungus pests.

There is no need to direct attention to the employment of shade in general but there is need for careful inspection of the kind used and its effects in different localities, and for directions about the adoption of shade trees more suitable than many of those at present in use.

But the proper use of shade is only one item in an immense number of agricultural operations of which the peasant proprietors are completely ignorant, and have no opportunity of learning, unless instructors are sent amongst them, not to lecture, but to demonstrate by actual work in their fields.

The Grafting of Nutmegs.

Mr. T. J. Harris, Assistant Superintendent of Hope Gardens, has been successful in grafting nutmegs. His method is as follows :—

Stocks ready for grafting ten months after sowing; still in bamboos.

Select the tree which bears the largest nuts, construct rough but level stages of different heights around the tree; draw some of the main branches down to the stages with wire attached to pegs driven into the ground: place moss or cloth under the wire to prevent its cutting the bark of the branch. The strongest *only* of the shoots should be used as scions.

Cut a thin slice of the bark from the side of the seedling stock, taking care to cut through the cambium, this cut to be about two inches long and about 4 inches from the base of the plant. Make a corresponding cut in the side of the scion at the point at which it is of the same diameter as the stock (it may be eight, nine or ten inches from the tip of the shoot) and opposite the cut on the latter.

Place the two cuts together at once and tie tightly with raffia or grafting tape. Allow them to remain for two months, watering carefully meantime; at the end of which time a small notch is made with a very sharp knife on the scion just below and on the opposite side to the union. Eight or ten days later the notch is made deeper by cutting out a little more wood; this time nearly severing the scion from the tree.

A week after take a sharp pair of shears and complete the cut.

Take the grafted plants at once to a cool moist corner out of the reach of hot dry wind.

Two weeks later the top of the stock may be cut off close down to the union.

After six weeks' stay in the cool, moist corner, they may be gradually hardened off to the conditions of the plantation, and when ready can be planted out.

Remove the raffia or grafting tape when the first young leaves begin to develop on the scion.

Pine Apples.

A series of experiments were carried out with Ripley Pines, chiefly in regard to the correlation of the colouring matter in the leaf, and the quality of the fruit and the results are given in my Report for 1898-99.

The question of the proper distance to plant is an important one. We first started to plant at 3 feet apart in the rows, with rows 5 feet apart, thinking that at this distance it would be possible to keep the land clean by cultivators drawn by mule or horse, and so reduce the cost. This was quite feasible while they were in the "plant" stage, but as the plant ratooned the fruits on the side shoots weighed them down breaking off many, and exposing the side of the fruits of all to the sun causing "sun burn." Other distances were tried, until it was finally decided that 2 x 3 feet was the proper distance, the reason being that although the hand cultivation necessary for the first year's growth is expensive, by the second year the pines so shade the land that there is little or no growth of weeds beyond a few climbers. The plants are close enough together to prevent leaning and consequent sun burn.

An experiment with artificial manures under the direction of Mr. Watts in 1899, gave no results, except perhaps to prove that with proper manual cultivation and a sufficient supply of moisture, the greater part of the Hope land contains all the plant food required by Pine Apples.

The experiments are being continued on a poorer soil.

Mr. Cradwick makes the following observations on pine-apples in the English market. The one pine-apple being sold in England is the Smooth Cayenne, but not as many people would have us believe, on account of its superior quality. The chief reason it sells so well is that it is a good looking pine, a fruit of good size, fine colour, and a handsome top, the weight ranging from 3 to 8 lbs., but the average about 4 to 6 lbs., larger not being required in England. The second reason for the Cayenne selling better than the much finer flavoured Ripley is that it gets to market in better condition. Many dealers lost money over the Ripleys being black in the centre, although apparently good on the outside. Mr. Geo. Monro of Covent Garden stated that if Ripleys could be got to market in good condition, they would run the Cayennes out

of the market. There is a good market in England for pine apples at all seasons, a three-pound fruit will always fetch 4s. retail, if in good condition; fruits weighing 5½ to6 lbs, if not too plentiful, sell retail at 8s. to 10s.

There is a good demand for pines before the St. Michael's fruit arrive, which is generally about the beginning of June, although they are by no means plentiful before August.

Rubber.

Some of the plants of Central American Rubber (Castilloa sp.) have grown to a height of over seven feet. Para Rubber (Hevea sp.) also continues to grow well, some of the trees having reached a height of 15 feet. Fifty more have been planted out. Ceara Rubber (Manihot Glaziovii) fruits regularly and plants are raised from the seed and distributed.

Kickxia elastica grows slowly and is subject to attacks of scale insects. None of the seeds received have ever grown.

Sugar

In confirmation of a planter's testimony in my last Report on cane D 95, another planter writes as follows:—

"I have very great pleasure in reporting most satisfactory results from No. 95 cane: under ordinary conditions the yield from plants and 1st ratoons has been 1½ tons Muscovado Sugar and 1½ phns. rum per acre for crop 98/9 (a Planter's year) this was increased to 2 tons and 2 phns., and this number very materially assisted in rendering the crop a record one. I find that it stools out wonderfully well, giving from 10 to 13 plants; it is robust and erect with good tops; a soft rind, giving a trash weighing but about 250lb., for the 1,000 ground. It will bear a drought every bit as well as the variety common to Vere as has been proved by recent experience.

"The ordinary cane in an average year yields me ¾ ton and phs., and in a very favourable crop such as 1897-98 1 ton and 1 phn."

ADDITIONS AND CONTRIBUTIONS TO THE DEPARTMENT.

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Europe.

British Isles.

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Colonial Reports, for 1897, 1898, and 1899. [Col. Sec.]
Garden, Oct. 20, 27, Nov. 3, 10. [Purchased.]
Gardener's Chronicle, Oct. 20, 27. Nov. 3, 10, [Purchased.]
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Journal of Botany, Nov. [Purchased.]
Nature, Oct. 18, 25, Nov. 1, 8. [Purchased.]
Pharmaceutical Journal, Oct. 20, 27, Nov 3, 10. [Editor.]
Sugar, Sept. [Editor.]
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Notizblatt, Berlin, Nov. 1900. [Director.]

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Mémoires de l'Herbier Boissier, No. 20, 21. [Conservateur.]

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Timehri, July 1898 to Dec. 1899, Part II.

Trinidad.
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Pharmaceutical Journal, Nov. [Editor.]

Ottawa.
Annual Report of the Experimental Farms, 1899. [Dept. of Agri,]

UNITED STATES OF AMERICA.

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Scientific Bureaus and Divisions. [*Directors.*]
Division of Entomology. 26 (Proceedings of the Twelfth Annual Meeting of the Association of Economic Entomologists.)
Circulars—No. 41 (Regulations of Foreign Governments regarding Importation of American plants, Trees and Fruits.) No. 42 (How to control the San Jose Scale)
Farmers' Bulletin No. 120 (The Principal Insects affecting the Tobacco Plant.)
Report No. 64 (Field Operations of the Division of Soils 1899, with Maps.)
Report of the Chief of the Division of Soils for 1900.

Experiment Stations.

Illinois. 60 (The Economic Entomology of the Sugar Beet.)
Kansas. Newspaper Bulletin—Weather Reports for Oct. and Nov. 1900.
Press Bulletin No. 72 (Fattening Steers without Hogs.)
" " No. 73 (Cultivated Blue-Grasses.)
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Wisconsin. 41 (The Anomalous Dispersion of Cyanin.)
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American Journal of Pharmacy, Dec. [Editor.]
Botanical Gazette, Chicago. Nov. [Editor.]
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The Forester, Jan.-Oct., 1900. [Publishers.]
Torrey Club Bulletin, Nov. [Editor.]

SOUTH AMERICA.

Report on the Botanic Station, British Honduras. [Superintendent.]
Bolitim da Agricultura. Sao Paulo, Brazil. No. 3. [Director.]

POLYNESIA.

Planters' Monthly, Hawaii, Oct., Nov. [Editor,]

SEEDS.

From Rev. W. Griffith, Kingston

Theobroma bicolor

From R. K. Tomlinson, Esq., Lacovia

Palicourea pulchra

From Dammann & Co., Italy.

Aster, dwarf mixed
" German "
" Victoria "
Balsam, Double Camellia, mixed
" Double Rose "
Coreopsis grandiflora
Dianthus chinensis, double mixed
" Heddiwigi " "
Mignonette, Fiametto
" Machet
Phlox Drummondi, mixed
" " nana compacta, mixed
Zinnia elegans fl. pl. Miniatur
" " plenissima, mixed
" " " pumila, mixed

From Messrs Herb & Wulle, Naples—

Carnation, Margheritæ—
White Perfection
Yellow, and yellow ground
Centaurea imperialis, mixed
Commelina Sellowiana
Trachelium caeruleum
Dianthus chinensis, fl. pl.
Dolichos unguicularis
Helianthus cucumerifolius, mixed
Heliotrope giganteum
Lobelia erinus, Crystal Palace
Mignonette, Paris marked
Morrenia odorata
Phlox Drumondi, grandiflora
Portulacca grandiflora
Salvia splendens, Ingenieur Clavenad

From F. DuCane Godman Esq., Horsham, England—

Argemone grandiflora
Meconopsis

From J. Moir Esq., Edinburgh—

Musa sp.

PLANTS.

From F. DuCane Godman, Esq., Horsham, England—

Aquilegia Skinneri
Choisya ternata
Koelrenteria paniculata
Rose "Crimson Rambler"
" "Carmine Pillar"
Rubus phœnicolasius
Sparaxis pulcherrima

From Dr. Bell, Blackheath, England.

Asparagus Sprengeri
" tenuissimus
Begonia "Baroness Rothschild"
Clivia
Cut-leaved Blackberry
Diplacus sp.
Francosa ramosa ("Bridal Wreath")
Funkia undulata

HERBARIUM.

From Prof. Millspaugh, Field Columbian Museum, Chicago.

100 Specimens of Yucatan Plants

[Issued 5th Jan., 1901.]

JAMAICA.

BULLETIN

OF THE

BOTANICAL DEPARTMENT.

New Series.] FEBRUARY, 1901. Vol. VIII. Part II.

TWO OPPOSING FACTORS OF INCREASE.

By Prof. J. C. Arthur.*

The energies of the plant are used for two general purposes: the development and maintenance of the vegetative parts, and the formation of special reproductive bodies. In some respects the efforts of the plant in these two directions are antagonistic. The vegetative part consists of root, stem. foliage, etc., and at first, and sometimes for a long period in the life of the individual, the energies of the plant are wholly absorbed in increasing the size and promoting the functional activities of these organs, all being connected with the welfare of the individual plant. After a time special reproductive structures are developed. consisting of seeds or spores, and the accompanying parts that aid in their protection and dissemination. They find their use in continuing the race, that is, in providing for another generation of indivuals.

The formation of the vegetative part and the formation of the fruiting part may be treated as separate tendencies in plant life. They rarely proceed *pari passu*, for usually if one is favoured, the other is less favoured. This is popularly expressed by saying that the plant runs to leaves, or runs to vine, or on the other hand that it runs to seed, or it overbears.

The portion of the plant having economic value for food belongs sometimes to the vegetative, sometimes to the reproductive side. Most fodders, and many culinary vegetables, such as cabbage, radish, lettuce, and asparagus, belong to the vegetative part, while the grains, fruits, and such vegetables as peas, beans, tomatoes and egg plant, belong to the reproductive side. The object of cultivation is to increase the size and quality of the part used, and it is evident therefore, that one requirement of the husbandman must be to learn the conditions which promote the development of the particular side of the plant to which the crop in question belongs.

* Reprinted from a most interesting collection of Essays entitled "Living Plants and their Properties," by Professors J. C. Arthur and D. T. MacDougal, published by Messrs. Baker & Taylor, New York.

It has been pointed out that among the lower animals, a sudden check to growth increases reproduction. I wish to expand that statement into the much broader and more widely applicable generalization that a *decrease in nutrition during the period of growth of an organism favours the development of the reproductive parts while abridging the vegetative parts.* The converse, that an increase in nutrition favours the vegetative parts while abridging the reproductive parts, is equally true.

Unimpeachable statistics are not abundant, for experiments bearing directly upon the problem have not been undertaken, and serviceable data culled from the supplementary records of other experiments are not very complete or numerous, Enough are obtainable, however, to lend very material aid toward establishing the generalisation.

The cultivator employs no method so frequently for enhancing the value of his harvest as increasing the fertility of the soil. It is a method of giving the plants a greater supply of nutriment, whereby they grow larger and yield more. If the principle just stated holds true, however, the increase will be greater proportionally for the stems leaves and roots than for the seeds and fruits. The data provided by Latta from experiments conducted in Indiana bear this out. Wheat grown upon fertilized and unfertilized areas averaging the results of three seasons, 1889-91, showed a decided gain in both straw and grain due to the richer soil but upon examining into the relative increase of straw and grain it is very evident that while the increase in yield of grain was considerable, it was by no means so great as the increase of straw, and that the proportion of straw to grain was, in spite of the increased yield, in reality lessened. (See Table I., page 23.) Essentially the same results are evident in data obtained by Caldwell in Pennsylvania with corn, averaging the results of ten years, 1881-90, (omitting 1887, the crop being destroyed by insects.) (See Table II.)

A very different method of increasing yield is the treatment of seed grain before sowing to a short bath in hot water. It is especially interesting to find that this method develops the same reciprocal relations between the vegetative and reproductive parts of the harvest as in the preceding cases. In a crop of wheat (see Table III) thus treated it was found that while the total weight of straw and grain was both as a whole and separately increased by the hot water treatment, the yield of grain was lessened as compared with the yield of straw.

If we turn from the statistical method of demonstration and appeal to general observation, an overwhelming array of facts can be brought to bear. It is a common observation that plants in too rich soil run to leaves instead of fruit. Every farmer knows that he can expect little or no grain from an excessively rich spot of ground, although the plants grow far taller and larger. The orchardist root-prunes his trees to bring them into bearing, when they prove to be unusually backward; the florist permits his plants to become pot-bound to induce them to flower more freely; certain slow acting diseases, e.g, peach yellow, and cotton rust, increase and hasten the fruiting A wide range of such general facts could be cited, familiar to every one having experience in such lines. In this connection Professor Atkin-

son, of Cornell University, has called attention to the longer time that elapses before spores are formed when certain bacteria are provided with more abundant food material. A customary culture gave a crop of spores in 15-20 hours, a culture with fewer germs (second dilution) in 36 hours, and one with still fewer germs (third dilution) in 48-72 hours.

The prolificacy of weeds in sterile soil is a matter of common observation. The great ragweed in poor soil produces a crop of seeds when but a few inches high, and the same is true of other weeds, especially noticeable in normally tall ones. Wild plants rooted in thin soil on rocks often bear single flowers as large as all the remainder of the plant. Analogous development may be seen in some alpine plants.

As a summary of the evidence already brought forward it is plain that the environmental conditions of plant existence have a disproportionate effect upon the two sides of plant life, the vegetative and the reproductive. An increase in available supply of food, as when the farmer fertilizes his fields, an earlier and stronger start in spring as in the case of wheat treated to a bath in hot water before sowing, the larger amount of food as when fewer bacteria are placed in same amount of culture media, all show a favouring action upon the vegetative part greater than obtains with the reproductive part. On the other hand, checking growth by root pruning or by keeping plants in undersized pots, reducing the general vitality by slow disease, and depriving the plant of sufficient soil and moisture, show a favouring action upon the reproductive part in hastening and multiplying the formation of flower and seed far in excess of the development attained by the vegetative part.

As a factor to insure perpetuity this law is evidently important in guarding against extermination, for the poorer the conditions for growth, the more effort the organisms puts forth toward seed-bearing. One cannot fail to be impressed by the thought, however, that if this be a general law of nature, it would seem to imply that the weakest and least favoured individuals, being most fruitful, are most likely to be perpetuated, which is in evident contradiction to the accepted theory of natural selection and to common observation.

There is, however, another factor which comes into play here, as a corrective of this tendency to deterioration of the race, and it is to this law that special attention will now be directed.

In all the methods of increase in rate of growth, so far brought forward, the change has been due in the main to external agencies, and the increased growth was found to be correlated with decrease in amount of reproduction. There are, however, methods of increase in rate of growth, arising from causes inherent within the organism, that tend in quite a different direction, in fact, are opposed to those already cited The best illustration, and the only one to be given in this article, is that shown by the size of seeds. It may be stated as a general law that *large seeds produce stronger plants with a greater capacity for reproduction than small seeds of the same kind.*

That larger seeds produce stronger plants, that is, plants possessing both heavier vegetative parts and larger yield of fruit, can be shown by abundant experimental data.

To be sure there is quite a common belief that the size of the seed has no material effect upon the product; that, provided a due regard be paid to vitality, any size of seed will answer the purpose of propagation. This belief is one of long standing, and is also held by some men of eminence. Sir Joseph Banks, one of the leaders in agriculture of a hundred years ago, advocated the use of small seed as answering the purpose of the farmer "as effectually as the largest." He had wheat especially in mind, and as the largest grains contain the most flour, the use of the large instead of the small seed for sowing seemed to him "un-necessary waste of the human subsistence." In recent years the distinguished scientist, Haberlandt, has given expression to essentially the same opinion. He believes it is chiefly the strain and the favourable conditions for growth that influence the product, and not the weight of the seed. He doubtless represents the opinions of a large percentage of cultivators of the present time, inclusive of many good thinkers. Probably a fair statement of the general opinion would be that if a strain is to be kept up to its full vigour, or if improvement is desired, careful selection of the largest seed is indispensable, but that the difference between the use of the large and small seed will not be noticeable in the first year's crop. This view is not, however, borne out by experiment, as we will see.

The amount and strength of the early growth from the seed has been studied by Marek, who experimented with beans and peas. The seeds were laid between moist blotting paper for seventeen days, and then measurements were taken of the length and diameter of the primary and lateral roots and of the stem. The figures all stood higher for the large seeds than for the small seeds, except for the length of the pea stem. Similar experiments were carried out by Von Tautphöus, who used from two to four sizes each of wheat, barley, rye, oats, corn, beans and peas. He measured the lengths of the plumule and radicle from day to day for two weeks. His conclusion was that the larger and heavier the seed, the stronger the development. He found, however, an apparent exception in peas, as did Marek, in which the main root and stem are shorter the larger the seed. But in this case it was noted that the extra strength is expended in lateral growth, forming a thicker stem and more side rootlets, thus bringing the apparent anomaly into line. A subsequent experiment by Marek was carried somewhat further. Three sizes of English beans were planted April 24th, and their growth noted up to maturity, July 12th, with the result that the larger the seed the taller the stems and the more numerous and larger the leaves. It also occurred to him to test the force exerted by roots of seedlings in piercing the soil, and in this respect also the offspring of large seed showed marked superiority over those from small seed.

Taking into account now the harvest. we find some excellent experiments with clear results. Trial of large and small seed roughly separated by sifting was made by Goff with onion, cauliflower, turnip and cabbage, with some gain in favour of the large seed in all but the last, and also made by Latta with wheat, who also obtained gain for the large seed.

Lehmann separated peas into three grades, large, medium, and

the larger seeds were possessed of greater inherent strength than the smaller, the number of seeds growing from each lot being 480, 478, and 423 respectively. The yield in peas, pods and vines, taken separately or together, and estimated per plant or as total weight, gave the largest figures for the product of the largest seed, and intermediate figures for the product of the medium seed. (See tables IV. & VIII.)

An experiment in this line with corn was conducted by the writer in 1889. Thirty kernels from a single ear of white dent corn were separately weighed of which six grew that were over 400 milligrams each, and nine that were under 300 milligrams each. The product of these fifteen plants gave a greater average weight of ears for the large than for the small seed, which was also true of the cobs and kernels taken separately. (See table V.)

Thus far, we have given the results of experiments in all of which the seed was provided the same ground space, without regard to size, and the data show that the large seeds give larger returns than the small seeds,

It would be natural to suppose that if the small seeds were placed correspondingly closer together, or in other words, if the seeds were planted according to weight instead of number, the results might be reversed. For it is evident that the same weight or measure of seed will contain a much larger number in case of small seeds than of large, and in planting the small seeds will require less ground area for development, and consequently a greater number of plants can mature upon an equal space

This phase of the question has been tested by Lehmann. He planted 188 grams each of large, medium and small peas upon equal sized plots of ground, and although there were twice as many small seeds as large, and nearly once and a half as many medium seeds as large, still the harvest was greatly in favour of the larger seeds, both per area and per plant. (Data in table VI., page 25)

A practical lesson is very pointedly brought out here, that in sowing farm seeds the amount of the harvest depends quite as much, and it may be more, upon the quality (size) of the individual seeds as upon the weight or measure sown per acre.

Is it not apparent that large seeds show great superiority over small seeds in numerous requirements that enter into successful plant life? In the first place, a larger proportion germinate, and this evidence of the possession of greater strength is followed up by more vigorous growth and the display of increased capacity for overcoming obstacles.

The resulting plants attain to greater development, as the size of leaf, length of stem and weight of any part or of the whole plant abundantly proves. It is especially noticeable that in this display of greater vigour both vegetative and reproductive parts are benefited; and while the individual plants are making a more successful fight in promoting their present welfare, they are enabled to provide more abundantly for the next generation, by producing a better crop of seeds.

Although the proposition in relation to size of seed, with which we started, has been illustrated and established so far as present space permits, yet in order to compare more fully the tendency of the powers of the plant derived from the two sources which for convenience we may call acquired and hereditary, the former coming from

food, light, warmth, and other external conditions, and the latter from the energy stored in the seed, it is necessary to bring forward still other data. We may venture to formulate this proposed extension of the law relating to the size of the seed thus: *large seeds give rise to plants with a greater development of the reproductive parts and less of vegetative parts, than small seeds do.*

It is intended here to directly compare the reciprocal relations of the two sides of the plant as influenced by the parent seeds. The data may be taken by weighing the fruiting portion and comparing it with the weight of all the remainder of the plant, both done when at their best development; or other methods may be used.

Excellent data are supplied from the researches of Lehmann (see table VIII). He grew large, medium and small peas, over 400 of each lot, and obtained plants that were heavier for the larger seed in both their vegetative and their reproductive parts, i.e., the leaves and stalks for the vegetative part, and the peas and pods for the reproductive part. And yet when the weight of the vegetative portion is compared with that of the reproductive portion of each lot, it is clear that the fruiting part has attained a stronger development in comparison to the remainder of the plant in the lots from larger seeds. To state the facts in another way, the larger seeds not only grow larger plants, but those which have fruiting parts more strongly developed than the associated vegetative parts.

Interesting data are furnished by Birner and Troschke using oats and peas, and by Marek with peas. The last investigator found that the weight of peas of first quality was nearly three-fourths of the whole harvest raised from large seeds, and only about one third of that from small seeds. (See table VII). In this case, therefore, the large seeds not only gave a much better total yield but far more seed material of high grade with which to continue the train.

Marek, in Germany, experimenting with oats (see table IX), and Plumb in the United States, with oats (see table X), have demonstrated the same fact. Both have provided data which show that the amount of grain in comparison with the straw was greater in case of large seeds than of small ones.

Statistical evidence oft his kind might be greatly extended although observations have rarely, if ever, been instituted with this particular end in view. Casual observations give no data to this part of the enquiry, as the differences are obscured by other factors which stand out more prominently. What the eye cannot detect, however, is readily and unmistakeably revealed by the rule and balance.

So far as data can be marshalled at present there appears good reason to believe that large seeds, besides giving rise to larger and more fruitful plants, also possess an inherent tendency to accentuate the reproductive side of the resulting development. When peas are sown, the largest seeds not only give rise to the largest plants, with the greatest weight of pods and of seeds, but to a greater excess of fruitage when compared with the remainder of the plant; and in a similar way with other kinds of plants, the largest parent seeds give the greatest returns of fruit and daughter seeds, both absolutely and also in comparison with the growth of leaf, stem and root. It is to be understood, of course, that we are not attempting to deal with single plants, but

with sufficiently large numbers to neutralise individuality and small accidents, which sometimes produce most unaccountable variations.

If we consider the bearing of all the data now brought forward, it seems reasonable to assume that in the ultimate analysis we are dealing with acquired and inherited tendencies. In the one case the impulse or stimulus to development comes from without; it is environmental, and acts more strongly upon the somatogenic portion of the plant, while in the other case it is inherent in the organization of the seed and derived from the parent plant. Whatever the explanation of the origin may be, however, it seems certain that these two opposing factors of increase play an important role in the economy of nature. As the food supply is lessened, a greater effort is made on the part of the parent plant to enhance the chances for perpetuity; but at the same time the largest seeds, having the greatest potentiality, stand the best chance in the future struggle; and although the best nourished plants produce the fewest seeds, their greater size gives them decided advantages over seeds from starved plants. The two laws acting together therefore, aid in maintaining the perpetuity of the species and its full measure of vigour.

TABLES.

I. Yield of Wheat on Fertilised and Unfertilised Ground.

(Weights calculated to the acre)

Treatment.	Weight of straw in pounds.	Weight of grain in pounds.	Proportion of straw to grain.
Unfertilised ..	2,813	1,602	1:0.56
Commercial Fertiliser ...	4,279	1,938	1:0.45
	3,971	1 884	1:0.47
Unfertilised ...	2,727	1,506	1:0.55
Stable Manure ...	3,699	1,818	1:0.49
	3,361	1,728	1:0.51
Unfertilised ...	2,894	1,512	1:0.52
Average unfertilised ...	2,811	1,540	1:0.55
Average fertilised ...	3,880	1,842	1:0.48

II. Yield of Corn and Wheat on Fertilised and Unfertilised Ground.
(Weights calculated to the acre.)

Crop.	Treatment.	Weight of stalks in pounds.	Weight of grain in pounds.	Proportion of stalks to grain.
Wheat	Unfertilised ...	1,367	958	1:0.70
	Fertilised ...	2,119	1,246	1:0.59
Corn	Unfertilised ...	2,430	3,498	1:1.44
	Fertilised ..	3,144	3,966	1:1.26

III. Yield of Wheat with and without Hot Water Treatment.
(Weights calculated to the acre.)

Treatment.	Weight of straw.	Weight of grain.	Proportion of straw to grain.
Untreated ...	3,737	1,716	1:0.46
Hot Water Bath ...	4,555	1,908	1:0.42

IV. Product from Large and Small Peas.

Size.	Wt. in grams of 100 seeds.	No. of seeds planted.	No of plants grown.	Weight of harvest in grams.			
				Peas.	Pods.	Vine.	Total.
Large ...	273	528	480	1,814	437	3,170	5,421
Medium ...	221	528	478	1,495	357	2,630	4,482
Small ...	160	528	423	998	280	2,010	3,288

V. Yield of Indian Corn from Large and Small Seed.

Size.	Av. Wt of kernels in milligrams.	Av. Wt of cobs in grams.
Large ...	312	53
Small ...	268	47

VI. Product from Large and Small Peas.

Size.	No. of peas in 188 grams.	No. of plants grown.	Peas harvested in grams.	
			per area.	Per plant.
Large ...	384	360	2,307	6.40
Medium ...	530	505	2,224	4.40
Small ...	780	680	1,590	2.34

VII. Product of Large and Small Peas.

Size of seed.	Wt. of peas in grams.		Wt. of pods in grams.	Wt. of vine in grams.	Proportion of vine to fruit.
	1st quality.	2nd quality.			
Large ...	1,375	554	1,519	4,185	1:0.83
Small ...	540	1,045	1,405	4,074	1:0.76

VIII. Product of Large and Small Peas.

Size of Seed.	Avr. Wt of single seeds in grams.	No. of plants.	Wt. of vine per plant in grams.	Wt. of peas and pods per plant in grams.	Proportion of vine to fruit.
Large ...	2.73	480	6.6	4.69	1:0.71
Medium ...	2.21	478	5.50	3.87	1:0.70
Small ...	1.60	423	4.75	3.02	1:0.64

IX. Yield of Wheat from Large and Small Seed.

Size of seed.	Weight of straw in grams.	Weight of grain in grams.	Proportion of straw to grain.
Large ...	2,411	3,039	1:1.26
Small ...	2,211	2,456	1:1.11

X. Yield of Oats from Large and Small Seed.

Size of Seed.	Wt. of seeds sown pr. 1000 in grams.	Weight of straw in ounces.	Weight of grain in ounces.	Proportion of straw to grain.
Large ...	35.4	556	190	1:0.34
Small ...	15.9	518	143	1:0.28

GRAFTING THE MANGO TREE.

By Horace Knight.

The object in grafting is to perpetuate any desirable fruit without having recourse to seeds. Experiments have proved beyond a doubt that sections of the mango tree will keep good for grafting purposes from three to six months' time, according to variety and to the constitution of the tree from which they are obtained. This gives us the opportunity to import sections of the most desirable class of tree from any part of the globe with a certainty of their growing when properly prepared and tied on.

After twelve years' close observation and a large number of experiments (more or less useful) made on the mango tree, the conclusion I have arrived at is, that no other tree is simpler to graft. The work can be successfully done by any one and at any time, whether the sap is active or dormant. The buds are certainly not so quick in coming when the sap is down, but they make up for any delay when once started.

Still, it cannot be said that grafting, when the sap is down, is the best time for the operation. On the contrary, the first three months in the year have proved to be preferable. All the remarks in this article apply to one process only—that is, the use of bark without any wood adhering to it. Up to date, the best material for tying on the grafts is ordinary candle cotton, procurable at the ironmongers, and generally sold in 1 lb. balls. The grafts are simple pieces of bark,

without any growth whatever on them. Of course there must be dormant buds, or eyes, on them. The pieces of bark may vary in length and width according to size of trunk or limb on which they are intended to be grafted. The most convenient size to use is a piece about twice the length of the width, and if taken off where rings exist, so that the ring is across the centre of the section, there will be two or three latent buds near the ring. The rings on the trunk and limbs denote the exact number of growths and rests the trees has made. At the point of every new growth, while resting, there is a whorl of leaves, and at the base of every leaf there is a bud which is capable of becoming a tree, and whether it is used for grafting during its infancy or ten years afterwards, it will develop with proper treatment. The older the bark, the easier it is to remove, and it is much handier to trim into shape. First cut out the section for transplanting, and, should the edges be bruised or torn, cut them away to sound bark. Now press the piece firmly on to the spot where it is intended to grow, and make a clean cut all round. Next take out the bark inside the mark, and put the prepared section in its place. Do not make it fit so tightly that it has to be squeezed in, but make it a nice fit. Now bind it on with the candle cotton with just sufficient pressure to make it touch its new parent. Avoid, if possible, binding immediately over the buds. The old notion that all air must be excluded to effect a union is a delusion so far as grafting a mango is concerned. There is no necessity for clay, grafting wax, or any other nasty stuff to ensure a good union but just the candle cotton. Now it may be that a section of bark has been prepared for transplanting which is much thicker than the piece taken out. Well, never mind; tie it on, and it will grow, although it is not a comfortable fit. Should the weather be hot and dry when the grafting is being done, the top may be left on the tree for shade, but it must be thoroughly ringbarked 6 or 8 inches above the graft. In two or three weeks' time cut the top off at the spot where it was ringbarked, and if the buds on the graft have started into growth remove the binding. All young shoots, except those on the grafts, must be rubbed off as soon as they appear. When a vigorous mango tree is suddenly deprived of all its leaves and the majority of its limbs, it immediately sets to work to repair the damages. Its ordinary means of utilising the sap being removed, it makes determined efforts to replace them. Every dormant bud will rapidly spring into growth, and while these are coming on, the trunk and remaining limbs will swell out to a surprising degree, this being the only means of using up the sap which the undisturbed roots are still pumping up At this stage the tree is highly impregnated with sap, and will take kindly to almost any shape or sized pieces of bark that may be put on it. When a piece of bark is removed while the tree is in this condition, the sap will pour into the breach, and a union with the bark introduced is soon effected.

When the young shoots which have sprung from the grafts have ripened, the old wood projecting beyond the graft should be [illegible] off close at the base of the new growth. As the new wood commences to grow, it will cover up the entire end where it was sawn off, and make very neat work of it. In the mango the term a "ripened" graft applies when the leaves and bark of the latter have taken [illegible] and to

green colour (chlorophyll), or when the shoot has rested and is ready to continue its growth.

In a matured growth the green colouring matter has been succeeded by a brown colour which varies considerably with age. (*Queensland Agricultural Journal.*)

IRRIGATION.

LETTER FROM GOVERNOR ROOSEVELT.

ALBANY, N. Y. Nov. 16, 1900.

TO THE NATIONAL IRRIGATION CONGRESS,
Chicago, Illinois.

Gentlemen:

It is with very real regret that I find my engagements here prevent my attending the meeting of your body. I believe to the last point in the vital necessity of storing the floods and preserving the forests, especially throughout the plains and Rocky Mountain regions. The problem of the development of the greater West is in large part a problem of irrigation. I earnestly believe in the national government giving generous aid to the movement, for it is not possible, and if it were possible, it would not be wise to have this storage work done merely through private ownership; and owing to the peculiar necessities of the case, much of the work must be done by the National and not by any State government.

Moreover, it is not only necessary to establish a great system of storage reservoirs to prevent the flood waste of the waters; it is also necssary to preserve the forests on the mountains and among the foothills. This means that, in the first place, there must be a wide extension of the existing system of forests reserves, and, in the second place, that these forests reserves must be managed aright. They cannot be so managed while there is the present division among federal departments of the duties, and, therefore, of the responsibilities of their management.

We are just getting to understand what is involved in the preservation of our forests. Not only is an industry at stake which employs more than half a million of men, the lumber industry, but the whole prosperity and development of the West, and indeed ultimately of the entire country, is bound up with the preservation of the forests. Right use of the forests means the perpetuation of our supply both of wood and of water. Therefore we cannot afford to be satisfied with anything short of expert and responsible management of the national forest reserves and other national forest interests. The forest reserves must be cared for by the best trained foresters to be had, just as the storage reservoirs must be built and maintained by the best engineers. There is the same need of trained skill in handling the forests in your best interests as there is in building the great dams which will some day bring population and abounding prosperity to vast stretches of so-called desert in the West.

Any man who has ever dwelt on the great plains knows what a series matter not only the water supply but the wood supply is to the

farmer, and of course every miner knows the same thing. Not only does the farmer need the water which the preservation of the forests itself also preserves, but he needs the wood too. So does the miner, so does the manufacturer, and so does the railroad man. The reservoirs cannot last if they fill full of silt, and the only way to prevent this filling with silt is to preserve the forests themselves. The forest is a great sponge for absorbing and distilling water. It is the great preventor of erosion, and erosion is always the danger point in any irrigation system.

Without pretending to outline definitely a working scheme, I venture to point out that without the attainment of the following objects your plans must measurably fail:

First. Government study of the streams upon which your plans depend

Second. Government construction and control of great irrigation plants.

Third. The preservation of forests by the extension of the forest reserve system and hence of Government control of the forests.

Fourth. National protection and use of the forests under expert supervision.

Fifth. I urge you to see to it that private owners of forests in the West and East alike understand that timber can be cut without forest destruction (the Department of Agriculture will tell them how) and that the ownership of water rights in the arid country, and of forest lands anywhere entails public as well as private duties and responsibilities.

The East is interested in the commercial development of the arid lands of the West, just as the West is interested in the proper development of our harbour system and of our commerce on the high seas. No part of this country can be permanently benefited without a reflex benefit to the other parts. As Americans we are all interested in the progress of any part of our common country, and while your movement is of immediate benefit to the West, its ultimate benefit will be shared by the East as well. I earnestly hope that all far-sighted citizens, whether they dwell on the Atlantic or on the Pacific seaboard, or in the great Mississippi valley will appreciate this, and that Congress will give to your efforts the substantial backing that they deserve.

Sincerely Yours,

(Signed) THEODORE ROOSEVELT.

LETTER FROM SECRETARY WILSON,
NOVEMBER 20, 1900.
TO THE NATIONAL IRRIGATION CONGRESS, CHICAGO.

Gentlemen:

The pressure of official duties stands in the way of my presence at your Congress, and I am exceedingly sorry it is so. It would have given me very great pleasure to meet you, and to discuss with you the two great agricultural problems of the West,—wood and water. But the necessity of setting rightly before the President and the people the work of the scientists of the Department of Agriculture in my annual report keeps me in Washington, where I hope I shall not be less useful to your cause than I should be if I came to Chicago. As it is, the Department will be represented by several of its scientists, and to

what they will have to say I invite your special attention. Through its search for economic plants that will thrive with little water, through its studies in the use of water for plants that need more, through its soil investigations, its forest work, and in many other ways, the Department of Agriculture is working at the problems which you are met to consider. These problems are national in their scope, and it is most fitting that they should be studied by the agencies of the National Government.

The water problem, like the forest problem, is essentially and primarily one of conservation and use. The waste of water in floods and the waste of forests by fire are parallel losses, each utterly hostile to the best interests both of the farmer and of the nation at large, and each preventable by perfectly well-known means. Enlightened public opinion and the use of expert skill are the two forces which are indispensable if we are to "save the forests and store the floods," in accordance with the admirable motto of your Congress. The creation of public sentiment will be immensely forwarded by your meetings, and you may safely look to the National Government for some part at least of the trained skill to study the water problems which confront the irrigator, and to make the forests of the Great West, and of the East as well, yield their products year after year and decade after decade in unbroken abundance. The vast developments which you are planning can become permanent only by the junction of wise conservatism with energy; and the natural resources which have cost you nothing must be protected and husbanded with the same trained care which you are making ready to bestow upon vast systems of artificial works for irrigation. The chief dangers which threaten your plans—one the failure to secure the building of these great works, the other the failure to protect the forests from which your waters come—are best met, like most of the dangers which threaten our country, by the broad diffusion of wise principles. *(The Forester.)*

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SEEDS.

From R. K. Tomlinson, Esq., Lacovia

Hibiscus Abelmoschus (Musk Ochra)
" Sabdariffa (White variety.)

From Dr. Grabham, Kingston.

Picrodendrun juglans, Gr.
(Rhus arborea, Macf).
Port Royal Senna

From Messrs. Reasoner Bros., Oneco, Florida.

Clematis Virginica
Cornus florida
Hibiscus Syriacus fl. pl.
Hydrangea arborescens
Melia Azedarach var. umbraculiformis
Myrsine floridana
Prunus virginiana
Pyrus americana
Quercus aquatica
" virginiana
Sassafras officinale
Thalia divaricata
Zanthoxylon clava-Herculis

From Queensland Acclimatisation Society.

Macrozamia Moorei
Melaleuca linarifolia
Sterculia quadrifida.

From Dr. Bell, Blackheath, London.

Annual Sunflower
Streptocarpus.

HERBARIUM.

From Dr. Grabham, Kingston.

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[Issued 4th Feb., 1901.]

JAMAICA.

BULLETIN

OF THE

BOTANICAL DEPARTMENT.

New Series.] MARCH, 1901. Vol. VIII. Part III.

TOBACCO.

When Columbus landed in 1492 in the West Indies he found the natives smoking a herb wrapt in a maize leaf, and the name of the herb was Tobago. In 1560 Jean Nicot distributed plants raised from seed to various parts of Europe. These two events give us the clue to the popular and scientific names of a drug the cultivation and preparation of which have now attained such enormous importance that Governments are supported by the revenue derived from its taxation, and colossal fortunes are made by its sale. Some idea of the scale on which the industry is carried on may be gathered from the statistics recently published in the "Year-book of the United States Department of Agriculture for 1899," where we read that during that year 266,661,752 pounds of tobacco, 4,542,016,570 cigars and 4,590,388,430 cigarettes were prepared in the United States alone, yielding a revenue to the Government of 52,043,859·05 dollars.

Small wonder then that the cultivators of so valuable a plant have shown great interest in all the processes of raising, planting, manuring and gathering the crop, and of drying, curing and preparing it for market; or that consternation has arisen in their midst at the origin and spread of a disease which attack the golden leaf, and bids fair to ruin the crop in some districts. It happens, moreover, that biological problems of wide significance are arising in connection with the complex art of fermenting the leaf so as to obtain the best flavour and strength, as well as in regard to the "Mosaic disease" above referred to, and the experience of Dutch growers, of which an excellent account is now to hand in Koning's "Der Tabak, Studien ueber seine Kultur und Biologie" (Amsterdam and Leipzig: W. Engelmann, 1900), shows that the employment of scientifically trained botanists in the technical laboratories of tobacco plantations is likely to be as usual an event in the future as in breweries and bacteriological laboratories.

The tobacco plant is exceedingly small in the seedling stage—eighteen thimblefuls of seed suffice for a hectare, *i.e.*, two and a half acres of

land—and is very carefully raised in pots and manured with pigeon's dug, planted out and weeded with extraordinary precautions against numerous enemies, and the leaves eventually picked by hand, sorted, tied into bundles, and hung to dry. It is a very exhausting crop, and requires much potash; and an astonishing amount of information has accumulated concerning the effects of different soils, manures, climate and other factors of the environment on the properties of the leaves. Moreover, there are numerous cultivated races in existence in the various tobacco-growing countries, as always occurs with planted crops.

During the process of slow drying the leaf may remain alive for two to three weeks, and the contained starch is converted into sugar, and further alterations result in an increase of acids. Proteids diminish and amines increase, but the nitrates and alkaloids (nicotin) should undergo no change. The slow alterations referred to are essential, and due to enzyme and other actions in the still living leaf; in artificially or rapidly dried leaves the arrest of such changes materially affect the flavour and burning of the tobacco, and naturally much turns on the age and quality of the leaf itself, the soil and season and other conditions of growth, &c.

The dried or "cured" leaves are next submitted to fermentation, a process of vital importance in the opinion of the tobacco expert, since it is this which determines the finer flavours and odours of the manufactured product. Fermentation is started by damping heaps of 15,000 to 30,000 lbs. of the dried leaves, packed in a special manner, and carefully watched by experienced workmen as the temperature rises. The process occupies three to four months, and the leaves are turned about once a month. The temperature rises to about 50-56° C., (122°-133° F.) and a loss of vapour, accompanied by a sweet and sharp odour, is noticed. The reaction may be neutral, though in some cases ammonia is given off, due to the action of undesired bacteria.

As would be expected, the fermentation is always accompanied by bacteria; but it has long been in dispute whether the essentials of the process are due to bacteria or to the action of special enzymes in the cells of the leaves.

Suchsland's researches had convinced him, not only that the fermentation is due to bacteria, but that a peculiar species of bacteria was specially concerned in the production of the approved flavour, and that the desirable properties of Cuban tobaccos could be imparted to inferior growths by introducing this species into the fermentation. Loew, on the other hand, maintained that the aroma and flavour depend simply on the action of enzymes or other cell-contents in the leaf itself.

Koning has investigated the various bacteria found in the fermenting heaps, and followed the changes induced in the tobacco.

But generally, the fermented tobacco undergoes little or no change as regards the total nitrogen or the nicotin, but organic acids diminish, and the sugars and nitrates are destroyed, and various aromatic substances are formed which affect the quality of the product.

Among the bacteria isolated, Koning claims to have found the species concerned in this remarkable neutral fermentation, and which imparts the aroma and flavour desired, and thus confirms Suchsland's results. He states that tobacco infected with the specific bacteria, fermented and made up, and then handed to experts, was selected by the latter as the superior from specimens containing other kinds. There is more than a touch of the dramatic in this scene of the experts sitting down to smoke a pair of cigars each, in packets of two, and labelled *a* and *b*, *c* and *d*, &c., only; but the evidence appears conclusive.

During the last ten years increased attention has been drawn to a disease of tobacco leaves, which causes irregularly alternating light and dark patches, and is known as the "Mosaic disease." Koning has established that this is infectious, and is carried through the fields by the fingers of the workmen who "top" the growing plants by pinching off the buds. He has examined the various fungi known to cause leaf-diseases in tobacco, and cannot refer it to these, and the presumption that it is a bacterial disease was strengthened by finding that certain manured soils were almost sure to have badly diseased plants on them; and that experiments showed that if a bit of diseased leaf, or a little of the sap from such is rubbed into a wound, the young leaves formed above the wound contract the disease. The same result follows if such sap is placed at the roots of healthy plants. But infection fails in all these cases if the sap is previously boiled.

Here may be mentioned that Adolf Mayer had proved the infectious nature of the filtered sap in 1885, and Beijerinck, working at this disease a short time ago (1898), had come to the conclusion that since no organisms could be isolated from the sap—the infectious nature of which he also proved—which will reproduce the disease, and since the sap *filtered through porcelain* still infects the plants, unless it was previously sterilised by heating, the causal agent must be a *contagium vivum fluidum*—a something of the nature of a poisonous enzyme, which not only diffuses through the plant-membranes—*e.g.*, the cell-walls of root-hairs—but increases as it passes from cell to cell.

Koning confirms Beijerinck's principal results, but concludes that since the infecting fluid may be heated to 100°C. for a few minutes without losing its powers, whereas alcohol and glycerine destroy the virulence, as also does *repeated* filtration through porcelain, the active agent is an *extremely minute organism*, which can traverse the pores of a filter. He compares the results with those obtained with the virus of various animal diseases from which no organism has as yet been isolated.

It should be borne in mind that the existence of organisms small enough to pass through a porcelain filter has been accepted by several authorities.

It thus appears that—without regarding the work as quite conclusive, which it is not,—we have here important contributions to several most weighty biological questions centered about the culture of an economic plant.—(*Nature, October, 11th, 1900.*)

IRRIGATION AND ALKALI LANDS.*

In many portions of the world, and oftenest in arid and semi-arid regions, the waters of some streams and wells, and particularly those of lakes, are too heavily charged with the salts of sodium—common salt, sal soda and Glauber's salt or sodium chloride, carbonate and sulphate respectively—to make it advisable to use them for the purposes of irrigation. These salts are a part of the waste products of soil production which ordinary vegetation is unable to use with profit, and which in countries of heavy rainfall are washed out of the soil nearly as rapidly as formed. Where these salts, however, do accumulate to any notable extent, it is designated an alkali soil, and will not produce normal crops of many of the forms grown in plant husbandry. . .

CHARACTERISTICS OF ALKALI LANDS.

The use of the term "alkali lands" as commonly employed, has quite a loose or wide application. Hilgard states that in California the term is applied almost indiscriminately to all lands whose soils contain unusual amounts of soluble salts, so that during the dry season or after irrigation the surface becomes more or less white with the deposits left by the evaporation of the capillary waters. . . Where these salts are well marked in character, crops are killed out entirely, or the growth is stunted much as is true of the black alkali spots of arid regions. On the rice fields of South Carolina, there appear during the dry stage of growth of the crop "alum spots," as they are called, upon which the rice may die out or be of inferior quality. Then, too, on the margins of the sea, where there are low lying lands periodically inundated by high tides, white deposits are again left when the surface becomes dry, and are injurious to cultivated crops when they have accumulated to sufficient strength, and these are sometimes spoken of as "alkali lands."

In the wide application of the term, then, "alkali lands" are those upon which soluble salts have accumulated in sufficient quantity, through evaporation and capillarity, to attract attention by their usually white appearance and their injurious effects upon vegetation. .

CAUSE OF INJURIES BY ALKALIES.

When the soil water about the roots of plants or germinating seeds becomes sufficiently strong with salts in solution, the osmotic pressure is so modified that a discharge of the cell contents into the soil takes place to such an extent as to produce what is equivalent to wilting. The cells are not maintained sufficiently turgid to permit normal growth, or they may have the pressure so much lowered as to cause death. The case is like placing the plump strawberry or currant in a strong solution of sugar, where it is observed to greatly shrink in volume. . . .

This, then, is one of the modes by which the injurious effects of alkalies are produced, and it should be understood that it matters very little what substance may be in solution in the soil water, so long as it is there in sufficient quantity to produce the osmotic shrinkage referred to.

* From "Irrigation and Drainage" by Prof. T. H. King, published by McMillan London and New-York.

Every one is familiar with the fact that too concentrated fertilizers may produce death to the plant, and it may be by this action. Applying the principle to the alkalies in the soil, it must be recalled that these compounds are all relatively very soluble in water, so that if only large quantities of water containing even small amounts of the salts are evaporated in contact with the roots of growing crops, the solution surrounding the soil grains may become too strong for good plant feeding, and even death may result. . . .

HOW ALKALIES ACCUMULATE IN THE SOIL.

Everywhere in the soil where there are sufficient changes in the air and the moisture, the soil grains are being broken down and dissolved by both physical and chemical means, and unless the rains are sufficiently heavy to carry the ever-forming dissolved salts away in the country drainage, they will be brought to the surface by capillarity and there concentrated until precipitated. The more insoluble of the plant-foods, and other salts which are not such, cannot charge the water sufficiently high to do serious harm, hence in common language and in the sense the term is here used, they do not become "alkalies."

But with the other salts the case is different. They are precipitated when the solution becomes strong enough, and form deposits on the surface or about the roots in the soil where water is being removed, but before this actually occurs one or both of the actions referred to above begins to take place.

In arid regions, where the alkalies proper are most abundant, rains enough may fall to slowly carry forward their formation, but not enough to carry them out of the land. From the higher levels and steeper slopes they are readily moved by surface drainage and wind action to the lower lands, where the amount may become so large as to form thick beds. During the wet seasons of such countries, these salts may sink into the soil, but to rise again when dry weather restores the action of capillarity.

In the humid regions, there is necessarily an even more rapid formation of all the true alkalies of arid climates; for fundamentally similar rock ingredients are subjected to identical weathering processes, but of a more intense nature, because the rainfall is greater. If, therefore, there occur conditions favourable to the accumulation of the soluble salts formed at and near the surface of the soil, these should be expected to show as alkalies. . .

INTENSIVE FARMING MAY TEND TO THE ACCUMULATION OF ALKALIES.

It has already been pointed out that during the growing season after vegetation has come into full action, nearly all of the rains which fall in humid climates are retained near the surface until they are evaporated, either through the growing crop or from the soil, and since these waters tend to form salts when they are in contact with the soil grains, they must tend to increase the salt content near the surface. It is plain, too, that the heavier the crops produced and the greater the number of them in the season, the less is likely to be the loss of any water from the field by under-drainage; hence the greater the tendency for soluble salts to accumulate. Then, if during the winter season of a country the rainfall is deficient, so that little leaching can take place, conditions become still more favourable for the accumulation of alkalies.

Further than this, if irrigation is practised during the growing season only, and this water also is evaporated from the soil in addition to the natural rainfall, it is plain that the amount of soluble salts in the soil must increase, both on account of that which may have been in the water applied, and that which this additional water may have been instrumental in producing from the soil on the spot through the processes of weathering.

Indeed, the more we study and reflect upon this problem, the more we are led to fear that in all arid climates, where irrigation is practised it will not be found sufficient to apply simply enough water to the soil to meet the needs of the crop growing upon the ground at the time, but, on the contrary, there must be enough more water applied to take up and carry away into drainage channels and out of the country to the sea not only the soluble salts which the irrigation waters carry, but also those which it causes to be produced from the soil and subsoil. In other words, it appears that an excess of soluble salts in a thoroughly irrigated field is not only a normal but an inevitable condition, unless sufficient leaching takes place; and if this is true, the sparing use of water can only increase the number of years required to bring the salts up to the danger point of concentration. . . .

CONDITIONS WHICH MODIFY THE DISTRIBUTION OF ALKALIES IN SOIL.

If the surface of the ground is kept naked and compact, so that the rate of evaporation may be strong, the alkalies will necessarily be brought to the surface and become concentrated there, hence in position to do the greatest harm to growing crops.

If thorough tillage is practised early, so that but little water is evaporated except that which passes through the roots of the crop, then the salts cannot become concentrated in a narrow zone, but, on the contrary, will be left all through the soil where the roots which are taking water are distributed. In those cases, therefore, where the general soil water is not too highly concentrated to permit normal growth, crops may prosper so long as the surface is kept shaded and thoroughly tilled.

It must be observed, however, and kept in mind, that the roots of plants cannot withdraw moisture from a soil without at the same time tending to concentrate the salts in solution in the zone where the roots do their feeding; hence, that if alkali waters are being used for irrigation, and in the long run if the purest waters are being used under conditions of no drainage, sooner or later the soil of the root zone must become so highly charged with the alkali salts that reduced yields are inevitable. . .

KINDS OF SOIL WHICH SOONEST DEVELOP ALKALI.

Where alkali waters are used for purposes of irrigation, and where sweet waters are being used under conditions of little or no drainage, the clayey soils are the ones which soonest begin to show the bad effects of concentrated salts. This is so for many reasons.

In the first place, the soils of clayey texture, are not as effective mulches as the sandy soils, hence, even where thorough tillage and shade are resorted to, there must necessarily be a larger rise of salt-bearing water to the surface to produce accumulation than is the case with the coarse sandy soils.

In the second place, when water is applied to a sandy soil, not nearly as much remains adhering to the surface of the soil grains and entangled between them, so that it quickly spreads downward farther below the surface than is the case with the clay. This being true, it takes less water to produce effective drainage, and the roots of the crop spreading farther in the sands, the salts cannot become concentrated as they may in the clays.

In the third place, since more water is held in contact with the soil grains of the clays, and since the total surface for chemical action to take place upon is very much larger in the clayey soils than in the sands, it is plain that soluble salts, including alkalies, may form more rapidly in one case than in the other, and hence, that the open, sandy soils cannot become alkali lands except under conditions which are extremely favourable to their formation. . .

DRAINAGE THE ULTIMATE REMEDY FOR ALKALI LANDS.

If it is true that alkali salts are formed from the decomposition of the soil and subsoil through the action of water and air, it is only too plain that where conditions are persistently maintained which allow the formation of the salts without permitting them to be removed by any cause whatsoever, there must come a time, sooner or later, when the amounts produced and accumulated in the soil shall reach the degree of concentration which is intolerable to cultivated crops.

Under the natural conditions of rainy countries, there is usually a sufficient amount of leaching to permit the white and black alkalies to be borne away in the country drainage with sufficient completeness to prevent their effects attracting general attention, and if the same processes obtained in irrigated countries it is plain that in these, too, the difficulties would not arise.

The conclusion is irresistible, therefore, that some method must be devised by which, periodically at least, sufficient water is applied to irrigated fields to pick up and carry out of the country the soluble alkali salts which are fatal to cultivated crops.

In the old-time irrigation of the Nile valley, the greater part of the land was under basin irrigation and thus thoroughly washed during some fifty days every year. Lands not so treated were the lighter sandy soils near the Nile, protected by only slight banks from inundation, and these dykes usually gave way as often as every seven or eight years, so that they, too, were occasionally thoroughly flooded. Under this system of washing and drainage the fields of the Nile were kept free from alkalies for thousands of years. But at the present time, when what are called more rational methods are being applied, but with no attention being paid to freeing the soil from the accumulation of alkalies, these salts have been concentrated to so serious an extent that already many acres have been abandoned. The probabilities are that long, long ago the same more rational methods (?) now being practised had been tried and found inadequate or inapplicable, on account of the accumulation of alkalies which they permitted, and the old irrigators learned to be content with a system which, although more wasteful in some ways, still kept the dreaded alkalies under control. It is not improbable that if the full history of many abandoned ancient irrigation systems could be known, it would be found that not being able to command water sufficient for drainage, or not appreciat-

ting its need, alkalies were allowed to accumulate until the lands were no longer productive. It is a noteworthy fact that the excessive development of alkalies in India, as well as in Egypt and California, are the results of irrigation practices modern in their origin and modes. and instituted by people lacking in the traditions of the ancient irrigators, who had worked these same lands for thousands of years before. The alkali lands of today, in their intense form, are of modern origin, due to practices which are evidently inadmissible, and which, in all probability, were known to be so by the people whom our modern civilization has supplanted.

EUCALYPTUS AND MALARIA.

Evidence exists that fever has disappeard in houses in Jamaica which have been planted round with Eucalyptus trees. Whether this is to be accounted for by the fact that these trees absorb immense quantities of water from the soil, making it drier, or in some other way, is not quite certain, but the extract from Bulletin No. 25 of the U.S. Department of Agriculture (Entomology), "Notes on the Mosquitoes of the U. States," may be of interest in Jamaica. "In addition to the use of eucalyptus oil on the skin to keep mosquitoes from biting, the growth of Eucalyptus trees is said by certain persons to drive mosquitoes away, and trees of the genus Eucalpytus have been especially recommended for planting in malarial regions. Mr. Alvah A Eaton, of California, wrote us in 1893 that in portions of California where the blue gum occurs no other remedy need be sought for. Further than that, he stated that no matter how plentiful the mosquitoes, a few twigs or leaves laid on the pillow at night would secure perfect immunity. The same year Mr. W. A. Sanders, of California, sent the following interesting account of the value of eucalyptus trees in answer to our published request in Insect Life.

'I have the largest and oldest grove of trees of Eucalyptus Globulus in this part of California, and have had fifteen years of opportunity to study these trees as insect repellants, and deem it my duty to respond to your request on page 268 of Insect Life.

'Thirty-three years ago I spent a portion of one summer with a Dr. McConnell, who had just returned from some years of residence among the Eucalyptus forests of Australia. We were in the Sequoia (Sequoia sempervirens) forest of the coast region of our State. The mosquitoes were so bad that it was nearly impossible to work during days when there was no wind. The doctor assured me that our common mosquito was never found in the Australian Eucalyptus forests, and swamps, but added, There's a "spotted mosquito" nearly as bad there in some places. He, not being an entomologist, was unable to tell me whether the "spotted mosquito" was a species of the genus Culex, or of some allied genus.

'The doctor being a reliable, close observer, I determined to test the antimosquito qualities of the Eucalyptus; so when I began to improve my house here nineteen years ago, one of the first things I did was to get a lot of Eucalyptus seed from Australia and plant out a grove of the trees. The tallest of them are now over 140 feet tall, and can be seen

for 20 miles around. My house stands in the midst of these trees. My irrigating ditch, a dozen feet wide, of sluggish current, runs through the grove beside the house. There has never a single mosquito larva been seen in the ditch from where it enters the first shade of these trees to where it emerges from them 200 yards away, while above and below, mosquito larvæ are plentiful—not immediately below, but some hundreds of yards away, where the water stands in pools and becomes stagnant among a growth of black walnuts and cottonwoods. My live stock pasture in this timber, going into the walnuts and back again under the Eucalyptus shade at pleasure. Frequently when the cows come up at night they bring a swarm of mosquitoes; occasionally some of them get into the house, but cause us so little annoyance that we scarcely notice them. Before this ditch reaches the Eucalypti it runs through a jungle of "fence bamboo" (Arundo macrophylla), where the mosquitoes are so bad that we avoid working there except on the windiest days And, though the ditch has more current there, the larvæ of mosquitoes are plentiful in the water till it reaches the Eucalyptus trees, below which point none are found till it has become stagnant away below them.

'People who have camped along the willows of King's River, only a few miles away, have come here with faces so blotched and swollen from mosquito bites as to be hardly recognizable, and have camped in the shade of "Sander's gum trees," as my grove is popularly called, for weeks, and declare that they never even heard a mosquito sing during that time.

'To the non-botanical reader I may say that this species of Eucalyptus is very tender to frost. The coldest weather ever known here, 19° F., above zero, killed thousands of them. Dr. Nuttall points out that the planting of Eucalyptus trees is not a sovereign remedy, from the fact that malaria still prevails at Tre Fontane, outside of Rome, in spite of Eucalyptus plantings. The mere planting of trees, however, is undoubtedly of use in malarial districts, since it will modify the condition of drainage to the soil.'

"In view of Mr. Sander's strong evidence it really appears that planting of Eucalyptus trees will be worth while in certain locations, not entirely (on account of the conflicting and not thoroughly satisfactory evidence) for mosquito protection, but incidentally for this use as well as other purposes."

Dr. Benjafield, a medical man who has resided for the last twenty-seven years in Tasmania, described the advantages of the Colony as a health resort lately at the Imperial Institute.

He said (according to *Nature*) that he was struck on his arrival in Tasmania, with the almost complete absence of consumption and bronchitis, and it was now three years since he has signed a certificate of death from the former disease. Last year the rural mortality of southern Tasmania was only 8.8 per 1,000, In Hobart 2,261 hours of sunshine have been recorded in one year, as against 1,158 at Oxford in England The climate of the Colony is one of the most even and excellent in the world. The atmosphere is pure, clear and crisp, and the general prevalence in the air, as indicated by the characteristic odour, of the essential oil of the Eucalyptus tree, existing in abundance in the Colony

especially near Hobart, appears to exercise a direct antiseptic influence against deleterious organisms of all kinds.

BREADNUT.

The breadnut (Brosimum Alicastrum, Sw.) is a high tree, native of Jamaica and Central America.

Fodder.—In the central parishes, where this tree grows in considerable abundance, the fruits, or "nuts," are largely used as feeding for stock, as are also the leaves of the tree, and they form a very valuable fodder for horses and cattle.

Wood.—The breadnut is an excellent timber tree; it usually grows erect, with a trunk about two feet in diameter which gives good boards, and as these take a high polish they are much prized for flooring and ornamental work of all kinds. Plants of this useful tree are now available for distribution from Hope Gardens.

ANALYSIS OF COCO-NUT.

The New York Botanical Garden is doing a great deal of useful research work in the well-equipped laboratories. Messrs. J. E. Kirkwood and W. J. Gies have been investigating the composition of the endosperm and milk of the coco-nut, and have lately presented the results of their quantitative analyses:

The following figures represent the average general composition of the endosperm: Water, 46 per cent.; solids, 54 per cent. Of the latter 98.1 per cent. is organic and 1.9 per cent. inorganic; 43.4 per cent. is fat and 21.9 per cent. 'crude fiber.' The fresh endosperm contains 0.75 per cent. of nitrogen, which is equivalent to about 4.7 per cent. of 'albuminoid." It is probable, however, that much of the nitrogen found exists in the form of 'extractives.' General analysis of the milk gave the following average data: Water, 95.3 per cent.; solids, 4.7 per cent. Of the latter 88.5 per cent. is organic; 11.5 per cent. inorganic. Three dozen determinations of gross relationships gave the following average weights and percentages:

Weight of whole nut, 610 grams.		
Integument, 170 grams		27.9 per cent.
Endosperm, 333 grams		54.5 per cent.
Milk,	107 grams	17.6 per cent.

The volume of the milk averaged 105 c. c.

STATISTICS OF PRODUCTION OF COFFEE IN THE NEW WORLD.

An interesting statistical report of coffee for 1900 compiled by Arnold Schramm of New York gives the following: Total arrivals of coffee at New York during 1900 were 342,274 bags of Maracaibo, 41,404 La Guayra, 8,035 Coro, 64,745 Savanilla, 172,301 Mexican, 204,739 Central American and 20,903 Jamaica.

Following differences between average of 19 years and receipts for 1900: Maracaibo, 31,017 bags more; La Guayra, 75,627 less; Coro, 540 less; Savanilla, 33,386 less; Mexican, 56,121 more; Central America, 23,062 less, and Jamaica 3,191 less

Stocks on Dec. 31, of following years, follows: Maracaibo, 1900; 38,354 bags; 1899, 7,323; 1898, 30,488; 1897, 37,800; 1896, 19,000; 1895, 47,200. La Guayra, 1900, 4,039; 1899, 187; 1898, 4,866; 1897 400; 1896, 1,600; 1895, 3,700; 1894, 1,001. Coro, 1901, 3,499; 1899, 450; 1898, nil; 1897, nil; 1896, 150; 1895. 3,000; 1894, 300 bags. Savanilla, 1900, 12,384; 1899, 6,222; 1898, 21,885; 1897, 20,800; 1896, 12,000; 1895, 21,000, and 1894 3,619 bags. Mexican, 1900, 2,648; 1899, 3,252; 1898, 5,749; 1897, 17,000; 1896, nil; 1895, 4,000; 1894, nil. Central American, 1900, 3,802; 1899, 2,454; 1898, 2,871; 1897; 5,500; 1896, 4,500; 1895, 7,000; 1894, 836 bags Jamaica, 1900, 2,370; 1899, 997; 1898, 2,386; 1897, 700; 1896, 1,700; 1895, 1,370, and 1894, 2,360 bags. (*Gleaner*).

CHOICE VARIETIES OF BANANA.

NOTE BY MR. WATSON OF KEW GARDENS IN GARDENERS' CHRONICLE.

On the subject of Bananas worth cultivating, I might point out the numerous delicious-fruited varieties which are yet unknown to the ordinary consumer of Bananas, which are as superior to what he gets from his greengrocer or fruiterer as Cox's Orange Pippin is to a Crab. A selection of the best of these first-rate varieties has been got together at Kew, and two years ago sixteen were sent to the new Agricultural Department in the West Indies to be distributed from Dominica. They bear such names as "Pisang Kelat," "Pisang Radji," "Pisang Mas," "Ram Kela," "Champa," "Lady's Finger," &c. Some of these have fruited at Kew.

"Ram Kela" has cylindrical brown-red fruits 6 to 8 inches long, and 2 inches in diameter. and the flesh is a rich yellow colour, with a flavour of Pine-apple. If the banana of the shops is worth a penny, then "Ram Kela" is worth a shilling.

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SEEDS.

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Stuart Pecan.

From Botanical Gardens, Hong Kong—
Pinus sinensis.

From Botanic Gardens, British Guiana—
Castilloa elastica.

HERBARIUM.

From Dr. Grabham, Kingston—
28 Sps. of Malvaceae.

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JAMAICA.

BULLETIN

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THE CONSERVATION OF SOIL MOISTURE AND ECONOMY IN THE USE OF IRRIGATION WATER.*

By E. W. Hilgard and R. H. Loughridge.

Amount of water required by crops.—It is not very generally understood how large an amount of water is requir d for the production even of fair crops; for the maximum of possible product is rarely obtained on the large scale, because it is not often that *all* conditions are at their b st at any one time and locality But from numerous observations, made both in Europe and in the E stern United States, it has been found that from 300 to over 500 tons of water are on the average required to produce one ton of dry vegetable matter. . .

These data should enable us to estimate the adequacy of the moisture contained in the soil at the b ginning of the dry season to mature the crop, provided we make due allowance for any growth already made at the time, and provided also that the estimates as to the water requirements derived from the experience of the countries of summer rains (the humid regions) hold good for the arid region also. The surprisingly successful growth and bearing especially of deciduous trees, without irrigation, despite a drought of five or six *months* in the "Franciscan climate,"† has led to an impression that a less amount of water may suffice under arid conditions For in the East, as many *weeks* of drought and intense heat would frequently suffice to destroy the crop.

Probable causes of this endurance of drought,—Doubtless the main cause of this remarkable endurance is to be found in the *much deeper*

* Bulletin 121, Agricultural Experiment Station, University of California.

† This name has been felicitously applied by Powell to the climate of middle and Southern California, which is characterized by the concentration of rains within a winter which is mild enough to constitute a growing season, while the summer is practically rainless.

rooting of all plants in arid climates; whereby not only a much larger bulk of moist soil is at their command, but the roots are withdrawn from the injurious effects of the hot, dry surface and air.

This deeper range of the roots is not the result of foresight on the part of the plant. It could not occur on Eastern soils, because of the intervention, in the great majority of cases, of difficultly penetrable subsoils; from which, moreover, plants could draw but little nourishment on account of their "rawness." In the arid region, as a rule, subsoils in the Eastern sense do not exist; the soil mass is practically the same for several feet, and in the prevalent soils is very readily penetrable to great depths. This, summarily speaking, is due to the slight formation of clay, and the rarity of heavy rains, in the arid region. And this easy penetrability of the soil implies, moreover, that being well aerated, the depths of the soil are not "raw," as in the East; and therefore that the "sub-soil," such as it is, may fearlessly be turned up as deeply as the farmer is willing to go with the plough, without danger of injuring the next season's crop, in all lands that are well drained; as, by reason of their depth and perviousness, is the case with most California soils.

We know the deep penetration of a peach root developing in a normally deep, well aerated "bench" soil, in a manner quite impossible to the same root when growing in land underlaid, as are most Eastern States ones, by a subsoil which either is too dense or too wet to be penetrated and utilized by the tree.

A root system of a typical Eastern tree root will stand in absolute need of frequent rains or irrigation to sustain its vitality, but a California tree may brave prolonged drought with impunity, being independent of surface conditions, and able to perform all its functions out of reach of stress from lack of moisture.* It is equally clear that it is to the farmers interest to favour, to the utmost, this deep penetration of the roots, both in the preparation and tillage of the ground, and in the use of irrigation water. For if the latter is used too frequently or too abundantly, the salutary habit of deep rooting will be abandoned by the plant, and it will, as in the East, be dependent upon frequent rain or irrigation; and also, owing to the small bulk of soil upon which it can draw for its nourishment, upon frequent and abundant fertilization.

Eastern immigrants as well as a large proportion of California farmers do not realize the privilege they possess of having a triple and quadruple acreage of arable soil under their feet, over and above the area for which their deeds call; and they tenaciously continue to adhere to precautions and practices which, however salutary and necessary in the region of summer rains, do not apply to this climate. The shallow ploughing so persistently practised results in the formation of a "ploughsole" that plays the part of the Eastern subsoil in preventing root penetration; limiting their range for moisture and plant food, and thus naturally causing crops to succumb to a slight stress of season which ought to have passed without injury, had the natural conditions been taken into proper consideration.

* The moisture determination under this tree gave, to the depth of eight feet, an aggregate amount of water of 1,058 tons per acre.

Roots follow moisture.—Very striking examples of deep rooting as the result of vertical moisture penetration can be observed in some of our native trees, which, while naturally at home on moist ground, are nevertheless sometimes found forming luxuriant clumps on the slopes and even summits of our coast ranges and foothills. If we examine the ground where this occurs in the case of California laurel, we will generally find that the soil in which they grow is underlaid by slate or shale standing on edge, into the crevices of which the roots penetrate, wedging them open; while themselves flattening out, and thus penetrating to moisture at considerable depths. The same may be observed in the case of the erect "bedrock" or foothill slates of the Sierra, on which native as well as fruit trees flourish in very shallow soils, sometimes reaching permanent moisture at the depth of ten or more feet below the surface. It can readily be observed during rains that there is comparatively little run-off from the surface of these lands underlaid by vertical shales.

On the same principle, the grape vines which bear some of the choicest raisins of Malaga on the arid coastward slopes, are made to supply themselves with moisture, without irrigation, by opening around them large, funnel-shaped pits, which remain open in winter so as to catch the rain, causing it to penetrate downward along the tap-root of the vine, in clay shale quite similar to that of the California Coast Ranges, and like this latter, almost vertically on edge. Yet on these same slopes scarcely any natural vegetation now finds a foothold.

Similarly the "ryots" of parts of India water their crops by applying to each plant immediately around the stem such scanty measure of the precious fluid as they have taken from wells, often of considerable depth, which form their only source of water-supply. Perhaps in imitation of these, an industrious farmer has practiced a similar system on the high benches of Kern River, and has successfully grown excellent fruit for years, on land that originally would grow nothing but cactus. Sub-irrigation from pipes has been applied in a similar manner.

The principle flowing from the above is simply that the most economical mode of using irrigation water is to put it "where it will do the most good," close to the stem of the plant or trunk of the tree, and let it soak downward so as to form a moist path for the roots to follow to the greatest possible depth. It is this deep *penetration to natural moisture*, as a matter of fact, which enables the small quantities supplied to produce such marked effects.

Basin irrigation.—It will be noticed that this principle is practically the same as that of the basin irrigation of orchards, which was originally largely practised in California, but has now been mostly abandoned for furrow irrigation. The latter has been almost universally adopted, partly because it requires a great deal less hand-labour, partly under the impression that the whole of the soil of the orchard is thus most thoroughly utilized; partly also because of the injurious effect upon trees produced at times by basin irrigation.

The explanation of such injurious effects is, essentially, that cold irrigation water depresses too much the temperature of the earth immediately around the roots, and thus hinders active vegetation to an injurious extent, sometimes so as to bring about the dropping of

the fruit. This, of course, is a very serious objection, to obviate which it might be necessary to reservoir the water so as to allow it to warm before being applied to the trees. In furrow irrigation the amount of soil soaked with the water is so great that the latter is soon effectually warmed up, besides not coming in contact too intimately with the main roots of the tree; along which the water soaks very readily when applied to the trunk, thus affecting their temperature much more directly. It is for the fruit-grower to determine which consideration should prevail in a given case. If the water-supply be scant and warm, the most effectual use that can be made of it is to apply it immediately around the trunk of the tree, in a circular trench dug for the purpose. When, on the contrary, irrigation water is abundant and its temperature low, it will be preferable to practice furrow irrigation, or possibly even flooding. As to the more complete use of the soil under the latter two methods, it must be remembered that while this is the case in a *horizontal* direction, yet unless irrigation is practiced rather sparingly under the furrow system, it may easily happen that the gain made horizontally is more than off-set by a corresponding loss in the *vertical* penetration of the root-system. This is amply apparent in some of the irrigated orange groves of Southern California, where the fine roots of the trees fill the surface soil as do the roots of maize in a corn field of the Mississippi States; so that the plough can hardly be run without turning them up and under. In these same orchards it will be observed, in digging down, that at a depth of a few feet the soil is too water-soaked to permit of the proper exercise of the root functions, and that the roots existing there are either inactive or diseased. That in such cases abundant irrigation and abundant fertilization alone can maintain an orchard in bearing condition, is a matter of course; and there can be no question that a great deal of the constant cry for the fertilization of orchards in the irrigated sections is due quite as much to the shallowness of rooting induced by over-irrigation, as to any really necessary exhaustion of the land. When the roots are induced to come to and remain at the surface, within a surface layer of eighteen to twenty inches, it naturally becomes necessary to feed these roots abundantly, both with moisture and with plant food. This has as naturally led to an over-estimate of the requirements of the trees in both respects. Had deep rooting been encouraged at first, instead of over-stimulating the growth by surface fertilization and frequent irrigation, some delay in bearing would have been amply compensated for by less of current outlay for fertilizers, and less liability to injury from frequently unavoidable delay, or from inadequacy, of irrigation.

Conservation of Soil Moisture,—Alongside of economy in the use of irrigation water, the conservation of the moisture imparted to the soil either by rains or irrigation is most important; critically so where irrigation is unavailable.

Utilization of winter rains and winter irrigation.—However strong is the popular demand for storage of the winter rainfall and flood waters, too many do not appreciate the importance of the storage they can command without the use of reservoirs, within their own soil mass. While there is a well-grounded objection to subjecting plough land to the leaching action of the abundant rains in the humid region,

no such objection holds in the case of lands lying within the limits of 20 to 25 inches of annual rainfall. Here the absorption of the winter rains should be favoured to the utmost, for the run-off is mostly a dead loss. Fall ploughing wherever the land is not naturally adequately absorbent, and is not thereby rendered liable to washing away, is a very effectual mode of utilizing the winter's moisture to the utmost, so as to bring about the junction of the season's moisture with that of the previous season, which is generally considered as being a condition precedent for crop production in dry years The same of course holds true of winter irrigation; the frequent omission of which in presence of a plentiful water supply at that season is a prolific cause of avoidable crop failures. Moistening the ground to a considerable depth by winter irrigation is a very effective mode of promoting deep rooting, and will thus stand in lieu of later irrigations, which, being more scant, tend to keep the roots near the surface.

Knowledge of the subsoil.—It cannot be too strongly insisted upon that in our arid climate farmers should make themselves most thoroughly acquainted with their subsoil down the depth of at least four, but preferably six or eight feet. This knowledge, important enough in the East, is doubly so here, since all root functions are and must be carried on at much greater depths. It is hardly excusable that a business man calling himself a farmer should omit the most elementary precaution of examining his subsoil before planting orchard or vineyard, and should at the end of five years find his trees a dead loss in consequence of an unsuitable subsoil. Similarly, no irrigator should be ignorant of the time or amount of water it takes to wet his soil to a certain depth. We have lately seen a whole community suffering from the visible decline of the thrift of its fruit trees, which occurred despite what was considered abundant irrigation; *i.e.* allowing the water to run for a given length of time, deemed to be sufficient. Yet on being called in to investigate the causes of the trouble, the station staff found that the irrigation water had failed to penetrate during the allotted time to any beneficial extent, so that the trees were, in the main, suffering from lack of moisture—a fact that could have been verified by any one of the owners concerned, by simply boring or digging a hole or two. But no one had thought of doing so, and all kinds of mysterious causes were conjectured to be at work in the suffering orchards. A definite knowledge of the rapidity with which irrigation water penetrates downward and sideways in his soil should form a part of the mental equipment of every irrigator, particularly in arranging his head ditches. For in sandy lands it may easily happen that when these are too far apart, the water near the head ditch is already wasting into the country drainage at the depth of ten or twelve feet, before any has reached the end of the furrows, or has wetted the lower half adequately Many such cases come under our observation, and such ignorance of the conditions governing one of the most important factors of success is hardly excusable in any one. Nor is the quality of the water used indifferent in this connection; for waters containing alkali will fail to penetrate the soil as quickly as would ordinary stream waters.

Preventing evaporation.—But supposing the moisture to have reached the depths of the soil, whether from rains or from irrigation, it is

essential that proper means be employed for retaining it in the land, and especially to prevent evaporation. That this is best accomplished by a mulch on the surface, and that the best mulch for the purpose, which need not be hauled on or off and is always ready, is a surface layer of loose, well-tilled soil, is now pretty well understood by all. But the extent to which the presence or absence of such a non-evaporating layer influences plant growth and fruit production in a critical time, is not so fully appreciated. We have seen trees and fruit grown this season on adjacent fields, with only a lane between, the soil and all natural conditions being absolutely identical; the only difference being the presence and absence of cultivation. In the present case the cultivation was omitted on principle by one owner, who considered cultivation superfluous on the loose, generous soil of Alameda creek; while his neighbour, across the way, held the opposite belief, and had this season cultivated to an extra depth to conserve moisture. The determination of the moisture held by the soil in July to the depth of six feet gave the following results:—

Depth in Soil.	Cultivated.		Uncultivated.	
	Per Cent.	Tons per Acre.	Per Cent.	Tons per Acre.
First Foot ..	6.4	128	4.3	86
Second Foot ...	5.8	116	4.4	88
Third Foot ...	6 4	128	3.9	78
Fourth Foot ...	6.5	130	5.1	102
Fifth Foot ...	6.7	134	3.4	68
Sixth Foot ...	6.0	120	4.5	90
Total for six feet ...	6.3	756	4.2	512

The difference of 244 tons per acre of ground shown by the analyses is quite sufficient, according to the data given at the beginning of this bulletin, to account for the observed difference in the cultural result. The cause of this difference was that in the *uncultivated* field there was a compacted surface layer several inches in thickness, which forcibly abstracted the moisture from the substrata and evaporated it from its surface; while the loose surface soil on the *cultivated* ground was unable to take any moisture from the denser subsoil. This is well illustrated by the familiar fact that while a dry brick will suck a wet sponge dry, a dry sponge (corresponding to the loose surface soil) is unable to take any water from a wet brick. Besides, the tilled surface soil forms a non-conducting layer protecting the subsoil from the sun's heat and the dryness of the air.

In the East, where this principle is well understood, it is considered that a surface layer three inches in thickness is sufficient to afford effective protection. But what is adequate in the region of summer

rains is quite insufficient in California and in the arid region generally. It takes fully twice the thickness mentioned, and preferably more, to afford protection against the drought and heat lasting five or six months at a stretch. Here again we find an important point in which our practice must differ from that of the East and of the Old World.

The beneficial effects of summer fallow in California are assuredly due quite as much to the conservation of moisture brought about by the tilled surface layer, as by the weathering of the soil to which the efficacy of the fallow is commonly ascribed. Witness the fact that weeds come up freely on summer-fallow as late as August, when unplowed land is as bare as a barn floor.

Similarly on our mostly new and unexhausted lands, the bad effects of weed growth are doubtless due fully as much to the waste of moisture going on through their leaves as to the competition with the crop in plant food. Hence all good orchardists are very careful about keeping their ground clean in summer; but it must not be forgotten that by doing so they quickly deplete their lands of vegetable matter, which requires systematic replacement if production is to continue normally. Yet of the two evils, the loss of moisture is more to be dreaded, and very generally in practice the more difficult to remedy.

THE JUNIPER CEDAR OF JAMAICA.*

Until comparatively recently some doubts have existed concerning the species of Juniperus found in the island of Jamaica and in the Bermudas respectively; and there has been a corresponding difference of opinion as to the nomenclature to be adopted. The difficulties of the case were primarily due to the absence from our herbaria, until quite lately, of any modern specimens of the tree native to Jamaica. Another source of confusion has arisen from the polymorphism so constantly presented by certain species of juniper, etc., thus there are the linear primordial leaves, which are free at the base, and spreading and there are the adult leaves, closely appressed, ovate, acute, convex, and often glandular at the back. Between these two forms are others, intermediate in form, according to the age of the shoot and its rate of growth. A particular tree or more frequently a particular branch, may, as is well known, produce only primordial, spreading leaves, or only imbricate scale-like leaves; or, again, both forms may co-exist on the same branch with or without intermediate forms

The receipt of excellent specimens of the Bermuda juniper through the kindness of Mr. Haycock, as well as of equally satisfactory specimens of the Jamaica species with which I have been favoured by Mr. Fawcett, induces me to offer a few remarks on the history and position of the two trees.

In the first place, it is obvious from the comparison of the specimens from the two islands that the Bermuda tree, generally called Juniperus bermudiana, is quite distinct, alike from the species growing on

* Extract from Article on *The Bermuda Juniper and its Allies* by Dr. M. T. Masters, in Journal of Botany, Jan., 1899.

the mountains of Jamaica and from that (now universally known as J virginiana) which occurs from New Brunswick to Florida on the eastern side of the United States, whilst the same or representative forms occur in the Rocky Mountains of Colorado, in British Colombia, and southward in Texas and New Mexico.

Extending over so vast an area, exposed to widely different environment, it is no matter for surprise that the species presents much variation. Many of these variations are in cultivation in this country, and are among the most elegant of hardy conifers.

The history of the Bermuda tree has been sketched by Mr. Hemsley in the Gardener's Chronicle for May 26, 1883, p. 656, and in the Report of the Botany of the Challenger Expedition.

The name bermudiana has been adopted by Mr. Hemsley, but whether the tree is really the original J. bermudiana of Linnæus is open to question, as will be shown hereafter.

Of the Jamaica plant, at the time Mr. Hemsley originally wrote, there were no specimens at Kew, though specimens existed in the Sloane Collection in the British Museum.

This West Indian species was referred by Grisebach (Flora of the British West India Islands (1864, p. 503) to J. barbadensis of Linnæus. Leaving for the moment the question of nomenclature, it may be repeated that an examination of Mr. Fawcett's specimens leaves no doubt that the Jamaica tree is specifically distinct from that of Bermuda. Moreover, as suggested by Mr. Hemsley and others, it is, in spite of some variation in habit, specifically identical with the virginiana of the main land.

There seem, therefore, to be only, two species. One is Bermudan, and known as a cultivated plant in the Azores, Antigua (De Ponthieu !) and Saint Helena. Possibly the same species may occur in Jamaica and other West Indian Islands, but there is at present no adequate evidence on this point.

The other species, J. virginiana L., is as has been said, distributed ever a vast area in the United Sfates, and has long been known as an inhabitant of the Blue Mountains of Jamaica. It occurs also, as seems most likely, in Cuba (Wright, 3187 !), in the Bahamas (Eggers, 4358), and in Antigua.

Prof. Sargent in litt. inclines to the view that the Florida form of virginiana is identical with the Jamaica species, and sufficiently distinct to constitute a separate species.

BANANA CONFERENCE.

A banana conference was held at the Jamaica Institute on the 19th December, last, His Excellency the Governor in the chair. Amongst those present were His Grace the Archbishop, Hons. H. E. Cox, L. J. Bertram, W. Fawcett, & Messrs. T. H. Sharp, H. H. Cousins, A. Clodd, A. Roxburgh, A. F. Clark, Watson, R. J. Hay, C. J. Hay, F. Verley, H. G. Ronaldson, R. Hotchkin, D. Campbell, H. G. Burnett, J. Barclay, R. A. Walcott, O. Plummer, F. G. Bather, J. Allen, J.

Powell, H. A. Cunha, J. Fisher, O. Feurtado, T. Kemp, Dr. Duerden & Capt. Baker.

Unfortunately the rains had blocked the railway and prevented the planters from the north-side attending.

His Excellency stated that one of the primary objects of the meeting was to introduce Mr. Cousins, the Chemist, to the agriculturists of the Colony. He thought that they were very fortunate in obtaining the services of Mr. Cousins, whose exceptional ability had been testified to on all hands in the most flattering manner. Dr Morris had written to him expressing his warm admiration of Mr. Cousin's attainments and his conviction that he would take a high place among technical officers of the West Indies and be of great service to Jamaica.

His Excellency then asked the Director of Public Gardens to open the discussion.

Mr. Fawcett said that the main point with Banana planters was to find out how to increase the bunch by a "hand"

Flowers.—He showed drawings of flowering shoots of the common Banana, one, of the shoot taken out when it was halfway from the ground to the top, the other when it was just at the top In both it was clear that the number of hands was already determined. In the lowest hand the fruit portion of the flower is about two-thirds of the whole length of the flower. This relative proportion is the same in all of the 7 or 8 of the lowest whorls of flowers, and so the bunch will be of 7 or 8 hands Then one or more occur with the fruit portion about one-half the length of the whole flower, followed by all the others in which the fruit portion is only one-third of the whole length.

This shows that no cultivation and no manure at this stage will affect the number of hands in the bunch,—the problem must be attacked at an earlier period.

In connection with the flowers comes the question of the possibility of improving the fruit by cross-fertilising and raising seedlings.

The difficulty is that the cultivated banana very rarely forms any seed. If we can discover the conditions that favour the formation of seed, it would then be possible to work by cross-fertilisation.

All the flowers which eventually form hands are female only, the anthers, or male elements being abortive; the flower or flowers which directly succeed these are both male and female, and all that follow are functionally only male.

Therefore fertilisation with pollen from another plant is alone possible, and that just at the time the flower shoot appears.

Leaves.—The most striking features about the Banana plant is its rapid growth, its early maturity, and the enormous amount of food produced in a small area.

This is accounted for when we find that almost the whole plant is composed of leaf-structure. The apparent stem is really made up of parts of the leaves.

The leaves receive substance from the air, and what is taken up from the soil by the roots must also pass into the leaves to be formed into material for the growth of the plant. When sufficient of this complex material is stored up in the root-stock, the flowering shoot is gradually formed, and at length bursts forth with the young bananas.

The leaf is not adapted to a windy situation like the finely-divided leaf of the cocoanut palm. The plant has been developed in sheltered valleys and ravines where no wind occurs to tear the leaf into shreds and prevent in doing its work of assimilating food.

Strong wind prevents the formation of large bunches and large fruit, and may wreck the plantation when the bunches are nearly ready for cutting.

Stem.—The apparent stem consists in reality of the bases of the leaves. The true stem or root-stock is underground It is a storehouse of food-material which goes to form new leaves, suckers, and the fruit. When the flowering shoots are about ready to appear, the leaves become much reduced in size, showing that the flowering shoots are absorbing a larger proportion than before of food-material, but probably at this late stage the removal would only affect the size of the individual fruits.

Roots.—The roots are thick and fleshy, keeping pace in length with the height of the plant, sending out small roots with root hairs all along its length. They have not much power of accommodation when meeting rocks, stones, &c., apparently dying back for some little way at the interruption and then branching again.

Evidently the natural soil is a loam with plenty of humus to retain moisture. If the soil in which bananas are planted is sandy, plenty of pen manure or green dressing should be ploughed in; if the soil is clayey, plenty of lime should be applied. as well as green dressing, and of course drains are essential.

The roots may be pruned with the plough at their tips as they keep pace with the height, so developing the branching system. This development of the branching of the roots is of great importance in giving the plant extended means of obtaining food.

Ploughing deep will encourage roots to go down, and so help in anchoring the plant.

Varieties.—Although the common Jamaica banana is the best that we know at present for general export, there are many varieties cultivated in the East Indies, which are described as being of superior merit, and would command high prices in England and the States as a special luxury. Some of these sent from Kew and Dominica are now growing at Hope Gardens.

It may be found possible to cross-fertilise some species, and so produce other varieties than are known at present.

Hon. T. H. Sharp made the following remarks :—

There are no hard and fast rules laid down for the cultivation of the Banana, but every planter should go about the matter by bringing his intelligence to bear on it, and to observe the conditions that exist on his property. I will give you an instance: You must prune often in St. Catherine, but in Clarendon if you prune close you get bad results; this is within a distance of 20 miles, as the birds fly. At the same time there are certain things which you cannot get over, and we should study them and try to improve: I speak of such things as ploughing. Although the advantages of ploughing are great, still the indiscriminate way of ploughing, constantly disturbing the system of the plant (perhaps just as it is bearing) is wrong. If you were to plough every

other row, and then let six weeks pass before you ploughed the other rows, it would allow the trees to recover from the first shock and to put out the new roots.

We should meet often, and compare notes; conferences of this kind are of great value.

Pruning.—I advocate not allowing any suckers to grow against the mother-plant, before the mother-plant has decided the number of hands it will give to its bunch; and this is known when the bulb base begins to enlarge, just at the part where the leaves start. The plant is then full grown, and it has been allowed to store all its energy for the making of the bunch, and as soon as it starts the sucker may delay the bearing, but it cannot lessen the number of hands. If you allow the sucker to grow before the bunch is formed, it will starve the bunch, by taking away the nutriment that is to make the bunch and feed itself. Open aspects are best, so as to allow free scope for the wind. Shelter belts do not save bananas. They make the wind whirl, and this gets into the fields, tangles up the broad leaves, and knocks the whole thing down.

Irrigation.—The taking the water around is the trouble; unless you have a large flow it will not move quickly enough to cover the land before it sinks, so you have to keep on a much larger quantity than you otherwise would.

I advocated applying water at the top of the trees by spraying. After the bunch gets to the top of the tree, if the weather is very dry, it will remain for weeks before it comes out, but by applying a little water at the top, it acts like a lubricant, and the bunch is produced very quickly. The rapid expansion of the head of the tree within a few days after about two quarts of water have been applied is apparent. We should spray the trees with water, which is a simple process. When we do this we will be able to regulate to some extent the production of fruit in time to meet the good markets.

Mr. Clodd, spoke on subjects Tillage and Implements; Economical use of land, (1) best distances, (2) inter cropping; shelter belts. Mr. Clodd after dealing with the implements used, said that to determine the most economical use that can be made of the land an opinion must be arrived at as to what it can do, either from cultivation on land adjoining or from one's own personal experience on similar soil, or better still, secure an analysis of the soil and compare it, if available, with analysis of soils in the same locality on which bananas were thriving and giving a good return. A good deal depended on the market one was working for. A spring crop was the one most profitable; and it was to this end that most of them were working. The close planting so far as one could judge from the present lands cultivated under that system showed great promise of being able to bring the bulk of the fruit in those months.

There were three most important ways where economy could be obtained in this method of planting. The distances at which bananas were planted and which appeared to be most generally adopted if the acreage planted was any criterion as to the best use of the land, were 14 feet and 15 feet square respectively. At either of those distances the results obtained would appear to show that it was the best if a

steady crop of fruit was desired all the year, without undue exhaustion of the soil. Lately a great many experiments were being carried on as to the best distance to plant, but these were of such recent occurrence that only time could tell what might ultimately be most generally adopted The growing of inter-crops had not been, as far as he knew, tried to any extent with perhaps the exception of Indian corn, and then if planted too thickly the effect was bad, and it would be doubtful if the money value of the corn when sold would compensate one for the injury done the banana trees. One reason why inter-cropping was not more practicable was that there was no reliable market for the produce when grown. If there was such a market there was no reason to doubt that by planting the catch crop strictly in the centre of the row that no ill-effects would result. As to permanent inter-crops, such as oranges, cocoa and many other economic trees, banana seemed to be an ideal cultivation by which permanent plantations could be established at a small cost. This depended on the soil and climatic conditions and the natural bent of of the planter himself. With respect to shelter belts such things had been tried in St. Catherine but were not of much use.

M.r H. H. Cousins, said he was glad to have this early opportunity of meeting so representative a gathering of those interested in the banana culture—He frankly confessed that he had everything still to learn about the culture of the banana, but he felt confident that the same principles and methods which had been applied to the cultivation of other plants and crops should enable Jamaica to greatly extend and improve its banana industry. It had been suggested to him that the agriculturists of Jamaica were anticipating that with the arrival of the new Agricultural Chemist, they would be able to obtain analyses of their crops and of their soil and thus to learn what manurial applications were necessary to maintain the productive capacity of the land. He would most stronly urge all practical men to banish this fallacy from their thoughts Such methods and such advice were alone justified on the basis of an analyst's professional fees, and had been markedly injurious to Agriculture in the past. He had only to mention the case of the turnip crop in England as an illustration of the fallacy of predicting manurial requirements by crop analysis. The turnip abstracts from the soil much nitrogen and potash but very little phosphate, from which the logical deduction would be that a turnip manure should contain much nitrogen and potash while phospate would be unnecessary. As a matter of ascertained practice the very opposite represents the real requirements of the crop. Phosphates are essential while nitrogen and potash are in the majority of cases quite unnecessary. Sound knowledge of this kind was not obtainable by *a priori* predictions from analysis but by actual field trials under agricultural conditions. He hoped that it would shortly be possible to start such field experiments on all typical soils in the Island where the banana was largely cultivated. As regards manuring, they must not lose sight of the fact that all such experiments must be made subservient to one dominating factor, viz., that of monetary profit. Unless a system of manuring paid, it could not be of benefit to the industry. He was led to believe that the very small extent to which Jamaica planters availed themselves of commercial fertilisers was due to a

distrust of their quality and genuineness. At present no legal control of fertilisers and feeding stuffs was in force and he hope to persuade the Government to pass an act similar to those in force in the United Kingdom and various colonies. He had seen the excellent results of fair and honest trade in manures in Barbados and hoped soon to see a similar state of things ensured in Jamaica.

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Phenological Observations, Canada, 1899
A Fresh Water Sponge from Sable Island
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Division of Vegetable Physiology & Pathology, 21 (Two Diseases of Red Cedar, caused by Polyporus Juniperinus n. sp. and Polyporus carneus Nees. 26 (Wakker's Hyacinth Germ, *Pseudomonas hyacinthi* (Wakker). 27 (The Wilt Diseases of Cotton and its Control).

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Alabama. 110 (Grapes.)
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Arkansas. 62. (Wheat Experiments.)
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New York 179 (An Anthracnose and a Stem Rot of the cultivated Snapdragon.) 180 (Miscellaneous Notes on Injurious Insects.) 181 A Fumigator for Small Orchard Trees)
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American Journal of Pharmacy, Mar. [Editor.]
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Plant World, Jan. [Editor.]
Progress of Forest Management in the Adirondacks. Ann. Report of the Director, N.Y. State Coll. of Forestry [J. Gifford.]
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Primitiae Florae Costaricensis, By H. Pittier. [Author.]

South America.

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Do. do. IV. 8. Typhaceae und IV. 10. Sparganiaceae von P. Graebner. Leipzig. 1900. 8vo.
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Green (J. Reynolds) Vegetable Physiology. London, 1900. 8vo. [Purchased.]

SEEDS.

From C. H. M. Trayner, H. M. Consul, Guatemala —
Guatemala Cocoa.

From Botanic Gardens, Hong Kong—
Quercus cornea.

From Mr. Elmer Stearns, California.—
Chinese Grape Fruit Pomelo (Pear shaped, length 6 or 7 inches)
German Winter Musk Melon (keeps two or three months.)
Pine Apple Winter (Musk Melon—keeps 3 to 5 months.)
Ginkgo biloba.

From Mr. Jenman, British Guiana—
Archontophoenix Cunninghamii
Chrysalidocarpus lutescens
Dypsis madagascariensis
Licuala Rumphii
Livistona rotundifolia
Pritchardia pacifica
Washingtonia filifera

From Southern California Acclimatizing Association, Santa Barbara—
Cupressus arizonica
C. funebris
C. glauca
C. guadalupensis
C. macrocarpa
Eucalyptus Lehmanni
Melaleuca leucadendron
Pinus Torreyana
Romneya Coulteri
Tacsonia exoniensis
T. Jamesoni
T. mollissima

From Botanic Gardens, British Honduras—
Hirtella dodecandra
PLANTS.

From Botanic Gardens, British Guiana—
Seedling Canes—D 109, 124, 125, 132, 135, 145, 170, 358, 366, 711, 721, 734, 755, 757, 790, 848, 916, 1082, 1108, 1143, 1168, 1234, 1438. 1439, 1483, 1488, 1850, 1880, 1896, 1897, 1959, 2028, 2093, 2190, and 36 varieties tied separately in small bundles

From Botanic Station, Barbados—
Seedling Canes—B. 109, 156, 208, 254, 306, 347. 379, 390

From Mr. Elmer Stearns, Los Angeles, Cal—
4 cuttings of Grape Vine Cipro nero
4 " Tinta Valdepenas
7 " Sabalkansky

HERBARIUM.

From C. F. Sullivan, Esq., Mandeville—
Solandra grandiflora

[Issued 2nd April, 1901.]

JAMAICA.

BULLETIN

OF THE

BOTANICAL DEPARTMENT.

New Series.] MAY, 1901. Vol. VIII. Part 5.

WASHED SOILS: HOW TO PREVENT AND RECLAIM THEM.*

THE EROSION, OR WASHING, OF AGRICULTURAL SOILS.

The denudation, or washing, of lands of the higher levels of the earth's surface is a process which no human precaution can wholly prevent. It has been one of the most important forces and factors in the geological changes which have so modified the surface of the earth. The present surface of the largest portion of the United States is made up of this "sedimentary" or "drift" material which has been moved from the place where it was formed through the disintegration and decay of the old crystalline rocks, by water, wind, or moving ice, and which has accumulated to a depth of hundreds or thousands of feet over nearly the entire surface of the country. It is estimated that the general surface of the land in the area of the crystalline rocks of the Piedmont Plateau has been lowered at least 2,000 feet by this continual washing. This vast amount of material has been slowly removed and deposited elsewhere by the very same agents which we are contending with to-day in our gullied fields; for this denudation, or erosion, is still going on, as it has been for ages past.

As a rule this denudation is exceedingly slow and the general level of large tracts of country is not lowered more than an inch or two in a hundred years. Where the change is as slow as this it is undoubtedly of benefit to the human race, as in the course of time it must carry off the soil which has been used over and over again for vegetation and expose fresh material to the roots of plants. With this slow change the natural forces are amply sufficient for the decay of the subsoil and for the conversion of this freshly exposed material into a good soil. When the rate of denudation is excessive, however, and more rapid than the natural decay of the subsoil material which is exposed, it may work serious injury to agricultural lands.

Along the banks of the Ohio River and in very many portions of the South hundreds of fields that were once covered with sturdy forests of oak, maple, walnut, and pine, and which bore under cultivation, after

*U. S. Dept. of Agriculture: Farmers' Bulletin No. 20.

being clared of the natural growth, large crops of wheat, maize, tobacco, and cotton, may now be seen furrowed with gullies as with the wrinkles of age, and abandoned to brush and briers.

A surface layer of good agricultural soil 6 inches deep resulting from the slow and gradual disintegration and decay of rocks and accumulation of humus may have required hundreds of years for its natural formation, and yet it is liable to be washed away in a single storm.

This excessive erosion, or washing, of lands may be prevented, and the already gullied fields may be recovered, and steep slopes of loose material may be held and prevented from washing—

(1.) By chemical means, in the application of manures and fertilizers and in the accumulation of organic matter, which change the texture of the soil and make it more porous and more absorbent of water, so that there is less to run off over the surface.

(2.) By means of cultivation and underdrainage, which prevent erosion by distributing the surface flow over the ground and increase the amount carried off by underdrainage.

(3.) By reforestation, or the planting of trees, which act mechanically to prevent washing.

(4.) By grass and similar vegetation, which bind the soil grains and prevent their washing away.

The erosion of a soil is caused by the wearing of the rain and snow waters which can not penetrate into the soil fast enough to be carried away by underdrainage, and which, by reason of the slope or contour of the land, run off over the surface carrying al ng particles of sand and clay. When this water accumulates in a depression in the fields the force of the torrent may be sufficient to cut out a great gully in a short space of time.

The extent of washing to which the soil is exposed depends upon the quantity of rainfall in a given time, the slope or contour of the surface, the textnre of the soil, the vegetative covering of the surface, and the kind and condition of cultivation. A soil composed chiefly of moderately coarse grains of sand, and having good underdrainage, will absorb the heaviest rainfall without much danger of surface erosion. A clay soil, on the other hand, into which the water can not percolate with anything like the rapidity of the precipitation, will be washed and gullied by the torrent of water which must flow over the surface.

CHEMICAL RELATIONS OF THE SOIL TO SURFACE WASHING.

It has been repeatedly shown by experiments and by the experience of farmers that a soil, as a rule, absorbs water more readily as the content of organic matter and humus increases. Surface erosion can, therefore, be largely prevented by such a system of cultivation and cropping as will introduce as large a quantity of organic matter into the soil as possible. A very old method of recovering washed and gullied lands is to place straw in the furrows while ploughing, the straw not only acting mechanically to hold the soil in place and prevent surface erosion, but also in a very efficient way to increase the quantity of humus, thus making the soil hold large quantities of water which otherwise would have passed off over the surface. In this simple way fields which have been badly washed and gullied and entirely abandoned may be recovered and made highly productive.

The most important thing in the recovery of waste fields is the incorporation of organic matter of some kind in the soil; pea vines, stubble, briers, or leaves from the forest may be used as a source of the organic matter. The straw from one acre of land which has been recovered, as mentioned above, will be sufficient to start the recovery of another acre, even if this be deeply furrowed with gullies. Where enough organic matter can be used as a surface dressing, this layer helps greatly to retain water and to make the underlying soil more absorbent.

As soon as a sufficient supply of humus has been accumulated and the lands are brought up to an adequate condition of fertility, clover or grass should be seeded, if the land is at all suited to these crops, or rye, oats, or field peas should be sown to help hold the surface. Little by little, but more rapidly than would be expected from the forbidding aspect of the field, the land can be reclaimed again and made productive through the accumulation of humus and organic matter. A soil containing a fair quantity of humus will wash less readily than one nearly destitute of this matter.

A soil containing a fair supply of lime is much less liable to wash than one similarly situated and exposed which is deficient in lime. The reason of this is that clays which are deficient in lime, when once brought into suspension by moving waters, will remain in suspension and keep the water turbid far a long time. Clays which are heavily impregnated with lime salts, on the other hand, are in a flocculated state, the fine grains of clay being held together and in contact with the larger grains of sand. This flocculated mass quickly settles and is originally not so easily disturbed and carried off by moving water. A field treated with an abundance of lime is thus less easily washed by heavy rains. The results of investigations by Schulze, Schloesing, and Hilgard have shown in a most emphatic way the beneficial changes which take place, especially in stiff clay soils, by the application of lime.

The change in the physical condition of the soil which is produced by the lime, and which is likewise produced by a number of other chemicals ordinarily used in commercial fertilizers, is another important factor worthy of consideration. A stiff clay soil is practically impervious to the penetration of surface water when it is delivered in such torrents as we are liable to have in our summer storms. A well-limed soil, on the contrary, although it may contain as much clay but in which the particles are flocculated or drawn together, is much more pervious to water, and the amount of water which the soil will carry down through underdrainage is increased, and the excess which has to flow off over the surface is diminished. The surface washing of cultivated fields, especially those which are naturally deficient in lime, can be greatly diminished, therefore, by the free application of this substance to them.

A number of the ordinary fertilizing materials have an important effect upon the texture of soils and upon the permeability of soils to water, but few systematic investigations have been carried on in this line and not much, except of local importance, has been definitely settled by experiments or by the experiences of farmers.

WASHING OF LANDS MAY BE PREVENTED BY METHODS OF CULTIVATION AND UNDERDRAINAGE.

The depth and character of the tillage are very important factors in the washing of lands. A field in a condition of fine tilth and ploughed to a depth of 10 inches will hold 2 inches of rainfall and absorb it very readily, and a soil in such a condition will suffer no surface washing from any ordinary rainfall. Where it is possible, therefore, land which is apt to wash should have the soil gradually deepened and be kept in a fine state of tilth so as to increase the storage capacity for excessive precipitations. This will not only save the surface from being washed and gullied, but it will also increase the store of moisture held by the soil, which is of very great value in the time of drought.

It is important also for this, as for other reasons, that the soil be covered with vegetation as much as possible throughout the year, as the roots and organic matter serve to bind the grains of the soil together. In some parts of Holland the drifting sands of the coast, which shift their position with every storm, often cover up valuable farming lands. Vast areas of these sands have been reclaimed and made productive by being covered with vegetation, while the roots and remains of organic matter hold the soil grains in place and prevent them from drifting and covering up more valuable lands. Any crop which requires very clean culture, as for example, cotton, is exhausting to the land for the reason that constant exposure of the surface to the sun and storms uses up the organic matter, makes the soil less porous, and the soil particles themselves are more easily washed away; so that, this clean cultivation is in its effects very favourable to excessive erosion.

Another very effective method, when properly carried out, to prevent the washing of lands is to underdrain the soil with tile or other drains. These drains carry off quite rapidly an excess of moisture, so that much more of the rainfall is absorbed by the soil and carried off through the drains and less washes over the surface of the land. Not only this, but a well-underdrained field is usually dryer and more porous, and has a greater capacity for absorbing the excessive rainfall and thus preventing surface washing. A field thoroughly underdrained with tile drains will carry off the water of any ordinary rainfall without any surface erosion. This method is very effective, but is likewise very expensive, and can not be used economically in extensive farming solely for this purpose of protecting the land from washing.

While the land may thus be made more porous and more absorbent of water—through the increase of the amount of organic matter or of humus, through the use of lime and other fertilizing material, through the deepening of the soil by gradually increasing the depth of cultivation, by so cropping it that it shall be covered with vegetation as much of the year as possible, and by underdraining the land—still, these methods may not be sufficient to so change the chemical and physical texture of the soil as to enable it to absorb the rain as it falls and to prevent an excess of water washing and eroding the surface where the contour of the land is such as to promote erosion from the surface flow of the excess of water.

It will be necessary in this case to provide for a more uniform distribution of the flow over the surface, and to prevent any accumulation of water which would have the effect of a torrential stream.

This is secured in a great measure by laying off the rows according to the contour of the surface, so that each row will have a very slight incline of not more than from 1 to 7 inches in 100 feet, and in which the flow of water would be so slow that there would be little or no erosion. Theoretically, this is a fine idea, to let each row carry off its own proportion of the excess of rainfall so gently that there shall be no erosion, thus acting as a miniature drain. Practically, however, it is often impossible to keep these rows from breaking through, and when the bed is once broken and the water overflows into the next row the accumulation of water is sufficient to break down bed after bed until the rows from all the field are discharging into this narrow channel.

To overcome this difficulty sidehill ditches may be used in which larger and more substantial ditches are provided, following very nearly the contour of the field, so that there shall be a fall of from 1 to 6 inches in 100 feet. The distance apart of the ditches will depend upon the slope of the field; with a very steep slope they should be close together, often not over 6 to 10 feet apart; with a gentle slope they should be at intervals of 15 or 20 feet, or even further apart, depending upon the texture of the soil and the contour of the surface.

These sidehill ditches are very easily constructed, being made almost entirely with the plough. A bank is formed by running a number of furrows, throwing the dirt toward the middle. The last furrow on the upper side is cleaned out with a spade to form the bottom of the ditch. If the plough is well handled it takes very little work with the spade to make a very substantial ditch. It is well to get the bank forming the lower side of the ditch sodded with grass to help hold it and to lessen the danger of its giving way during a heavy rainfall. When the slope is thus protected with a number of ditches at the proper distance apart, the rows can be given a rather steeper fall so that they shall run out into the drains at frequent intervals and not have to carry the water so far. These ditches have to be constructed with care and have to be strengthened where they cross any depression or sudden curve by building up an embankment with sticks and brush thrown across to support the embankment. Unless these ditches are thoroughly constructed they are worse than useless, for if they break they concentrate a volume of water upon one point in the field which would otherwise have been distributed over the surface, and this often forms a torrent which does great damage.

It is essential that these ditches and rows be run according to the contour of the surface of the land, and that there shall be no low places where the water would accumulate and gather force. They should always be run with a level, of which there are several forms on the market suitable for this work.

A more efficient, but at the same time much more expensive, method of preventing the washing of lands where there is a considerable slope is to terrace the fields so that there shall be level steps upon which the water can rest for a while and be absorbed. In terracing, the lines are run with a spirit level following the contour of the surface so as to give a perfectly level line. A furrow is run along this line, and a similar furrow is run along a lower contour, the distance apart depending upon the nature of the land and the slope of the surface, as in

case of sidehill ditches. Theoretically, it is intended to have the surface between these two furrows level so that there will be no chance for the water to run off over the surface. On a small scale this levelling can be done with a horse shovel, and the land thus put at once into a condition to prevent washing. In this case the banks of the terrace are sodded or seeded with grass to prevent them from washing. In field practice, however, the soil is moved gradually with a plough, the furrow being thrown always downhill and the soil gradually worked down to a level plain. There are several forms of reversible ploughs which are admirably adapted to this purpose, being turned readily from a right to a left handed plough, so that in going back and forth the furrow is always thrown downhill. It requires, of course, a number of years of such cultivation to get the surface into even approximately a level condition, but with patience and thorough cultivation the soil very quickly assumes a comparatively level aspect, and erosion is reduced to a minimum. This is a more expensive method, but if intelligently done it is much more efficient and much more durable than depending upon sidehill ditches to prevent erosion. As was said in the case of the sidehill ditches, unless this work is well done it had much better be left undone, as it may seriously injure the field.

Where erosion has proceeded so far as to render the land at present unfit for cultivation, or where the land is not needed for cultivation and it is desired to prevent erosion, the land should be given up to trees, herbs, or grasses of some kind according to one or other of the following methods.

RECOVERING GULLIED HILLSIDES BY REFORESTATION.

Forest ground is not subject to this erosive action of the rainfall because in a forest a large part of the rainfall never reaches the soil as 20 or 30 per cent. is intercepted by the foliage and evaporated before it reaches the ground The rainfall which reaches the surface is rapidly absorbed. as the soil is kept granular and loose and much more of the water is carried off by underdrainage rather than by surface drainage.

The forest covering protects the soil in the following ways :

(1) By preventing rain from falling directly upon the soil, the foliage of the tree crowns intercepting and breaking its force, the water reaching the soil more gently from the leaves and along the branches and trunks of the trees.

(2) By interposing a loose cover or mulch of litter formed by the fallen leaves and branches, which breaks the direct force of the raindrops and keeps the soil from being compacted or puddled by their blows.

(3) The deeply penetrating roots, and holes left from decayed stumps and roots of trees, assist in this underground drainage.

(4) The litter with the stumps and projecting roots and trunks of trees prevent the water from rapidly running over the ground and from gaining the momentum and force which is necessary in order to erode and gully the soil.

If the forest floor is not disturbed by fire, nor the litter trampled and compacted by cattle, it always reduces rapid surface drainage and largely, if not entirely, prevents erosive action.

RECOVERY OF WASHED SOILS.

Just as deforestation of hillsides and hilltops is the first cause for inducing erosive action, so is reforestation the most effective means in curing the evil. This has been demonstrated in France, where the Government and the farmers together have spent, during the last thirty years, over £40,000,000 and expect to expend three or four times that amount to reforest 1,000,000 acres of denuded mountain sides, the soil and debris from which has been carried by the torrents of water into the plain, covering over 8,000,000 acres of fertile ground and making it useless for agriculture. Sodding for pasture has been found mostly less effective and on the steeper slopes entirely ineffective.

Wherever the ground in the hill country is not fit for agricultural use it should be set and kept in forest, not only to make it produce a timber crop, but also to prevent the erosion which finally becomes dangerous to the lower valley lands. Wherever agriculture is possible and profitable there should be such a distribution of forest, pasture, and field as will secure the greatest immunity from erosive and torrential action of the waters. The forest should occupy all hilltops which, as a rule, have too thin a soil to allow profitable agricultural use; it should be kept growing on the steeper slopes where the water acquires the greatest momentum and the loosening of the soil by the plough furnishes a most favourable condition for erosive action; it should be placed on all rocky, uneven, agriculturally useless spots, because it will produce useful material even on such unfavourable situations, and, finally, forest belts should be maintained on long slopes alternately with fields and pastures, running along the brow of the slope of widths and at distances proportionate to the character of the land and the angle of the slope—on the steeper slopes closer together, on the gentler slopes further apart. These belts, acting as a barrier to break the force of the water, will prevent an undue accumulation of surface waters and will protect to a considerable degree the lower fields from washing. Farmers, therefore, living in the eroded hill country should start upon the work of reforestation with a well conceived plan. They should determine beforehand which parts ought to be in forest, and which they may reasonably expect to adapt again to agricultural uses. They should understand that they must begin this work at the origin of the evil, at the very tops of the hills where the water begins to gather and acquire its force, and gradually proceed with their work down to the lower levels.

PREPARATION FOR PLANTING FORESTS.

Although cultivation of the soil for tree planting in the manner practised for field crops is advantageous to the young plants for the first few years of their life, it is by no means necessary, and rough, broken and stony ground, which could not be ploughed and prepared for ordinary field crops can be readily planted in trees. If the ground is in such a condition that it can be ploughed, this is decidedly the best method of preparing the land. The ploughing should in all cases follow the contour of the hill and be as deep as possible, in order to allow as much water as possible to soak into the soil and so diminish surface erosion and prevent the young trees being washed out. The occasional gullies must be filled with brush and soil, or stones, rubble and dirt.

In the deeply gullied hill lands, where ploughing has become impracticable, other ways must be provided against the further erosive action of the water, which would otherwise be apt to wash out and uproot the plants. For this purpose it is necessary to break the force of the water by constructing brush dams across the gullies, and roughly fill in the latter with stone, gravel, earth, etc., in front and rear if they are shallow and at least in the rear if they are deeper. Where the ravines are especially deep and wide it may become necessary to supplement and strengthen the rough dam with a loose rubble embankment or a dry wall of stone. A simple and efficient method has been practised in France, which consists in filling up the ravine with brush placed lengthwise and keeping this down by poles laid across and fastened in the sides of the ravine. The waters are thus allowed to drain off, while the soil carried by them is retained in and over the brush, and in a short time the gulley will fill up of its own accord. Then alders and willows are planted along the edge and soon finish the work of securing the ravine against washing. The means for thus breaking the force of the water in the gullies and changing it from a rushing torrent into a series of gentle falls, and in part from surface drainage into subterranean drainage, and of filling up the gullies themselves will have to be devised in every special case as circumstances permit and the ingenuity of the operator suggests. The brush dam is preferably made of readily sprouting material, which becomes alive and by striking root adds to the firmness of the dam.

It is especially needful, as in all kinds of dams, to fasten the ends scarcely. According to the steepness, depth, and width of the ravine more or less frequent dams are necessary. After the brush dams, walls and other breastworks have been established, the waters may be allowed to do the work of filling up the gullies themselves, which they will do sooner or later, or else, where it can be readily accomplished, the filling may be done by hand.

It may be understood that unless this preliminary work is well done and systematically, beginning at the very tops of the hills where the waters start, it is not worth doing at all, since the water if allowed to get headway would soon wash away and destroy any imperfect work.

PLANTING.

To cover the soil as quickly as possible with a dense and permanent arborescent cover is the object to be attained. Where the soil has not been so far eroded that ploughing could be done, it might be best for the first season to sow field peas, or other crops that will readily grow and make a cover. This may be cut for green fodder, leaving a high stubble, and tree seed can be sown broadcast with the fodder crop in the early summer, or over the stubble after the crop is cut in the late summer and fall. The cheapest and most readily germinating tree seed should be looked for and the quantity used per acre should be lavish to secure a dense stand from the first. . . . . .

Where the ground is too much cut up and too uneven to permit of ploughing, recourse must be had to sowing of seed in plats, or planting of seedlings or cuttings by hand. This is naturally much more expensive, and therefore should be done with greater care and foresight. Plats may be made by loosening the soil with a hoe or spade, and sowing the seed in these seed beds covering the seed only slightly. The

plats should be 3 to 4 feet apart to make sufficiently rapid cover. The success of this method is, however, very questionable, as not only the germinating of the seed under the prevailing conditions is precarious, but rains are apt to wash out the seed or young seedlings. The surer method, however, will be found in planting seedlings or cuttings. Seedlings are not only expensive but also more precarious to handle, hence for the bulk of the plantation such kinds as can be readily obtained and propagated by cuttings are used, and if desired a sufficient number of seedlings of better kinds can be added to increase the timber value of the plantation.

The first and principal object being to break the force of the surface waters, the arrangement in setting out the plants should be as nearly as possible in horizontal and parallel rows along the brow of the hill, following the contours. To get a full cover as soon as possible the plants should be set not farther apart than 3 to 4 feet and even less, making from 5,000 to 7,000 per acre. If this is found too expensive, or for some reason impracticable to be done at once, the work may be reduced and divided into several seasons; the rows then may be made farther apart, say from 6 to 16 feet, according to the slope, and the plants in the row 2 feet, when the number will be one-half, or less . . . . .

Whatever is done in such a work of recovering lost ground, let this fact never be forgotten, that it is better to do a small part well than a large part indifferently which usually means lost labour.

GRASSES AND SIMILAR VEGETATION PREVENT EROSION AND WASHING OF AGRICULTURAL LANDS.

On gentle slopes a good turf of perennial pasture grasses, especially those with creeping rootstocks, prevents erosion, or washing, of lands, and short steep embankments may also be protected with this same covering. On longer and steeper slopes, however, this method is not so effective as that of reforestation.

In enumerating the effects to be obtained by the growth of grasses and other herbaceous vegetation on washing lands, or lands liable to be eroded, it should be stated that such growths are calculated to break the force of the rainfall and prevent its packing the soil; to render the ground more porous through the root penetration into the subsoil; to make the soil more absorbent and more retentive of moisture through the addition of humus to the soil from the decay of the plants; to retard the rate with which the surface waters flow off, and lastly, to bind the particles of soil together, which is especially effective in the case of light sandy lands and of newly formed embankments, whether of sand or clay.

The turf which would answer the present purposes should be composed of perennial grasses of varieties which have creeping rootstocks, and it is frequently essential that they be able to grow upon an impoverished and often hard soil. To secure a strong turf on lands of this character it is very important that the soil be put into the best possible condition. Where practicable the soil should be thoroughly ploughed or loosened, and some variety of field pea or clover be seeded down, such as the cowpea, well adapted to this purpose. These crops may either be cut off, leaving a high stubble to be turned under, or

the whole may be ploughed under, thus furnishing a quantity of organic matter to the soil as a preparation for the grasseswhich are to be seeded.

With this preparation of the soil Bahama grass is one of the best grasses for the purpose of preventing erosion, or of reclaiming eroded land. This should be planted by cutting up a turf rather than by seeding, as the seeds do not germinate very readily, even where they have been gathered in a mature condition.

Where the soil will support other good turf grasses of higher value for hay or pasturage, or where the soil can be brought into a condition to support them, these more valuable grasses should be introduced.

OIL OF AKEE.

Sometime ago Mr. E. Foster (Montego Bay), sent to the Director a small portion of oil extracted from Akee, and the residual cake. These samples were sent to Mr. E. M. Holmes, the Curator of the Pharmaceutical Society of London, and although they were small for the purpose, they were carefully examined in the Research Laboratory. Mr. W. Garsed has lately read a paper on the subject at a meeting of the Society which is given below, reprinted from the Pharmaceutical Journal.

In the discussion which followed the reading of the paper, Mr. Garsed said the oil might probably be used for most of the purposes for which palm oil is used at present, but they had not particulars either of the price or anything else to be able to give any definite idea of what its commercial value would be.

Mr. Peter MacEwan said that vegetable oil of this character is not altogether wanted to take the place of palm oil in soap-manufacture, but there is not in pharmacy a vegetable oil of the same consistence as akee with its bland properties. He thought it would be of interest to have a further supply of the oil with a view to having it tried for medicinal and pharmaceutical purposes.

Mr. W. Martindale said that, although akee did not seem to be so easily-oxidised an oil as linseed, it might replace some culinary oils, like coco-nut, which have a disagreeable smell and bad keeping properties. The question whether they would be able to grow the plants to an extent to compete with the palm oil or coco-nut oil was one which, however, he considered extremely doubtful.

NOTE BY MR. E. FOSTER.

At present it would be almost impossible to put Akee oil on the market, for, as a rule, the trees are never allowed to grow in abundance, Only a few are kept for supplying the table. But, taking into consideration the fact that akees can be grown on waste land with almost no care whatever (though care would improve them) and the *large amount of fat* the fruit contains, I believe that if the culture were taken up money could be made out of it.

The oil is expressed from the whole of the dessicated fruit,—only omitting the seed. Dessication can be artificially effected, but the

temperature must not run high. I have made common soap from the dessicated akee *pulp* without going to the trouble of expressing the oil. It saponifies very readily. Akee is well worth considering. The oil cake is palatable and nutritious.

For common soap, dessicate the pulp. In expression of oil, dessicate the whole fruit, there is no occasion to remove the red. It is difficult to express oil from the dessicated pulp, as on the application of pressure, oil and pulp pass through fine linen. Not so with the dried whole or half fruit, the oil flows readily, leaving a solid cake behind, of a savory smell and nut-like flavour, edible by human beings and animals.

The juice from the skin makes a vegetable soap but it grows mouldy quickly. I have not tried the seeds yet for oil.

Could the refined oil not be used as olive olive?

THR CHARACTERS OF OIL OF AKEE.

BY W. GARSED.

The oil of akee, handed to me by Mr. Holmes, is a yellow, non-drying, butter-like fat at ordinary temperatures, consisting of a liquid portion. and a solid granular portion.

It has a peculiar odour, and an oily, somewhat unpleasant taste.

In the diagram a comparison has been drawn between akee oil, palm oil, and olive oil.

Akee oil begins to melt at about 25°C., is quite fluid at 30°C,, but does not become perfectly clear until the temperature reaches 35°C. The melted oil on cooling begins to solidify at about 20°C.

The specific gravity was taken at a temperature of 99°–100°C., and compared with water at 15·5°C. The number found, 0.857, approximates closely to that of palm oil, which has a specific gravity of 0·8586 at a temperature of 98°–100°C.

The Hehner value is the percentage of insoluble fatty acid sobtainable by saponifying the oil, and decomposing the soap with a mineralacid.

The Reichert value is a measure of the proportion of volatile or soluble fatty acids. It represents the number of cubic centimetres of decinormal potassium hydrate required for the neutralisation of the volatile fatty acids obtained from 5 Grm. of the oil by the Reichert Meissl distillation process. The low figure obtained, 0.9, indicates that the amount of volatile acids present is practically nil. This is the case with most vegetable fats.

The saponification value represents the number of milligrams of potassium hydrate required to neutralise the *total* fatty acids in one gram of the oil.

The acid value represents the number of milligrams of potassium hydrate required to neutralise the *free* fatty acids in one gram of the oil. The value found was 20·1. The acid values of palm oil and olive oil, and most other fixed oils, vary considerably according to age.

The iodine value is a measure of the proportion of unsaturated or liquid fatty acids. It is the percentage of iodine absorbed by the oil when treated with Hubl's iodine solution.

The mixed fatty acids are obtained by saponifying the oil with caustic alkali, decomposing the soap with a dilute mineral acid, filtering out the liberated acids, washing with boiling water and drying.

Under a pressure of 13 millimetres the mixed fatty acids distil unchanged, at a temperature of 220°-225°C. The specific gravities of the acids from akee oil and palm oil closely correspond, in fact it will be noticed throughout the whole table that as a rule the figures for akee oil and palm oil closely approximate.

A comparison of the iodine values shows that the percentage of liquid, or unsaturated glycerides —olein—is considerably less in akee oil than in olive oil, and slightly less than in palm oil.

A comparison of the melting and solidifying points leads to the conclusion that the solid glycerides—palmatin—in palm oil have a higher melting point than those in akee oil, and this more than counterbalances the slightly higher pecentage of liquid glycerides in the former.

Separation of the Solid and Liquid Acids.

This is partially effected by treating the lead salts of the fatty acids with ether, in which the lead salts of the liquid acids are soluble, and those of the solid acids insoluble. The separation, however, has been shown to be incomplete, as the acids from the insoluble lead salts still give appreciable iodine values.

The acid regenerated from the ether-soluble lead salts was a pale yellow, liquid oil. Its iodine value was found to be 82·4; the lead salt was found on analysis to contain 27·9 per cent. of lead. For pure oleic acid theory requires an iodine value of 90, and a lead salt containing 26·9 per cent. of lead. This liquid acid is apparently impure oleic acid.

The acid regenerated from the insoluble lead salts had a melting point of 52°-54°C. It was washed with four successive small quantities of cold alcohol, to remove the last traces of the liquid acids. After this treatment it appeared as a white, finely crystalline powder, melting at 55°-56°C. Recrystallised from alcohol it melted at 56°–57°C., and repeated crystallisation caused no rise in the melting point.

This acid has not yet been identified. It may possibly be a mixture of palmitic and stearic acids, or it may be a near homologue of these acids. The constant melting points to the latter alternative, and the fact that the melting and solidifying points of palm oil and its acids are higher all round than those of akee oil lends weight to this idea, since the solid part of palm oil consists almost entirely of palmitic acid and palmitin.

Akee oil contains approximately about 50 per cent. of liquid glycerides, calculated as olein, from the iodine value; about 40 per cent of solid glycerides, and about 10 per cent. of the free acids contained in these glycerides.

The oil-cake consisting of the pressed seeds still contains 25 per cent. of oils, which can be extracted by solvents.

Twenty grams, cut small, dried in a water oven, and extracted in a Soxhlet apparatus with petroleum ether, yielded 5 grams of oil on distilling off the solvent.

The residue from the petroleum ether treatment was extracted with 90 per cent alcohol. The alcohol was distilled off, and

the dark-coloured extract warmed with acidulated water. Brown resinous matter separated, and a brown, acid solution was obtained, which gave slight, brown precipitates with Mayer's reagent, and with a solution of iodine in potasium iodide.

The acid solution was made slightly alkaline with ammonia solution, extracted first with ether, then with chloroform. The etherial and chloroformic solutions on evaporation yielded slight brown residues, of a faintly bitter taste. The residue from the alcohol treatment, extracted with warm water, yielded a considerable quantity of mucilage, which in its impure condition gives a precipitate both with lead acetate and lead subacetate.

To make a thorough examination of all the constituents of both oil and cake would be a lengthy operation, and would require a much larger quantity of material than was at our disposal.

I am indebted to Dr. Collie for much kindly advice in connection with the foregoing experiments.

Test.	Akee Oil.	Palm Oil.	Olive Oil.
Specific Gravity ...	°C 99-100 | 0·857 (Water at 15·5°=1)	°C 98-99 | 0·8586 (Water at 15·5°=1)	°C 15·5 | 0·914 to 0·917 (Water at 15·5°=1)
Melting Point ...	°C 25 to 35	°C 27 to 42·5	°C 2·5
Solidifying ...	°C 20	°C 21 to 27	°C +2 to −4
Hehner Value ...	93	94·2 to 97	95·4
Saponification Value ...	194·6	196·3to202·5	185 to 196
Reichert Value ...	0·9	0·5	0·3
Iodine Value ...	49·1	51 to 52 4	81·6 to 84·5
Acid Value ...	20·1		

Mixed Fatty Acids.

Specific Gravity.	°C 99-100 | 0·8365 (Water at 15·5°=1)	°C 98-99 | 0·8369 (Water at 15·5°=1)	°C 99 | 0·843 (Water at 15·5°=1)
Melting Point ...	°C 42 to 46	°C 47·7 to 52	°C 22 to 26
Solidifying Point ...	°C 40 to 38	°C 44 to 45	°C 21 to 24
Saponification Value ...	207·7	206·5 to 207·3	–
Iodine Value ...	58·4	–	86·1 to 90·2

ADDITIONS AND CONTRIBUTIONS TO THE DEPARTMENT.

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III : S. angustifolium and some Related Species New and Old.
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V : Two New Eastern Species.
VI : Additional New Species from the Southern States.
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SEEDS.

From Dr. D. Morris, C.M.G., Barbados—
Thrinax Morrisii
From R. K. Tomlinson, Esq., Lacovia—
Mahogany
From G. S. Jenman, Esq., British Guiana—
Euryale ferox, Andira surinamensis, Macrolobium acaciæfolium.
From Dr. Franceschi, Santa Barbara, Cal—

Acacia armata	Lavatera assurgentifolia
Albizzia lophantha	Lippia cuneifolia
Godetia amœna	Ricinus cambodgensis
" grandiflora	" sanguineus
" purpurea	" zanzibarensis
" quadrivulnera	Sollya heterophylla
" rubicunda	Tacsonia mixta
" viminea	Tetragonia expansa

HERBARIUM.

From Prof. H. Harold Hume, B. Sc., Florida—
74 Specimens of Fungi of Florida
From R. K. Tomlinson, Esq., Lacovia—
Lace Bark Flowers and Leaves.

[Issued 4th May, 1901.]

JAMAICA.

BULLETIN

OF THE

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PUPIL-APPRENTICES AT HOPE GARDENS.

Young men in limited numbers are allowed the privilege at Hope Gardens of receiving training in the elementary principles and the practice of agriculture.

They are not bound as apprentices, as it is found more convenient for purposes of discipline to engage them as labourers at the rate of 3/ per week for the first year, 4/ per week for the second year and 6/ per week for the third year. After three years employment can generally be found for them with planters, if they have proved industrious and capable.

Each apprentice has to make his own arrangements about board and lodging. A few rooms are provided in the gardens, where some of the apprentices are housed. This is a privilege, however, which cannot be claimed by any, but it is offered when vacancies occur, in the first instance, to apprentices whose friends live at a distance, and only so long as they give entire satisfaction.

Apprentices are required to work exactly in the same way as garden labourers, and to do anything and everything they are told in connection with the work carried on. No guarantee is given that they will be specially trained in any particular branch of the work, but they will be given opportunities to acquire a general knowledge of the following:—

1. *Cocoa.* Raising seedlings, potting, planting, pruning and training, curing.
2. *Citrus.* Raising stocks, budding, planting out, insecticides and their application, and general care of tree.
3. *Grape Vines.* Pruning and general care of vines.
4. *Pines.* Planting and general care.
5. *Nutmegs.* Raising stocks, grafting, planting out.
6. *Tobacco.* Raising seedlings, planting out, cultivation, cutting, and curing.
7. Propagation of plants generally, potting, watering and the details of nursery work.

Apprentices are also allowed to attend the demonstrations given for

half an hour each day, on the application of the principles underlying practical agriculture.

They are expected to purchase books which are recommended to them, and to study in their spare time.

They must be steady, punctual, diligent and painstaking, and any breach of discipline may be punished by a fine, or by instant dismissal.

At present there are no vacancies, but names may be sent to the Director with full particulars of age, place of education, attainments, &c.

NUTS.—I.

CHEROONJIE

(Buchanania latifolia, Roxb.)

As nuts are considered now to be of dietetic value, it may be useful to indicate from time to time such as are growing in the Botanic Gardens, or are already found wild in the island.

Cheroonjie is the name given in parts of India to the fruit and the kernel of a tree known to botanists as *Buchanania latifolia*. The fruit is said to be sweet and laxative, and is used to relieve thirst, burning of the body, and fever. The flavour of the kernel is described as between that of the pistachio and the almond. The kernels are eaten roasted with milk, or made up into native sweetmeats. They yield 50 per cent of oil, but this is scarcely ever prepared.

This tree is allied to the Cashew, but in the latter the top of the stalk becomes enlarged into a fleshy fruit. Both belong to the family *Anacardiaceæ*.

SOUARI OR BUTTER NUT.

(Caryocar nuciferum, Linn.)

The Butter Nut Tree is a native of British Guiana where it grows in the forests along the banks of rivers, attaining a height of 100 feet. Its nuts are kidney-shaped with a very hard woody shell, of a brown colour and covered with wart-like protuberances. The kernel is large and white with a very pleasant taste, and yielding by pressure a bland oil.

The wood is hard and durable, and is used for ship-building, mill work, &c. The plant belongs to the same family as Tea, viz.: *Ternstronemiaceae*.

A DWARF WEST INDIAN PALM.

In December, 1890, Dr. Morris discovered in Anguilla an interesting little palm "growing on broken limestone rocks. It was present in fairly large quantities, and the fan-shaped leaves were used for thatching native huts. The chief interest attached to this palm is connected with its dwarf habit. The largest and apparently most matured specimen did not measure more than about 30 to 35 inches in height, and the stem was about 2½ inches in diameter." This palm hitherto unknown to science was named *Thrinax Morrisii*.

Dr. Morris has lately sent seeds of this palm to the Botanic Gardens in Jamaica, accompanied by the following letter :—

The Commissioner of Agriculture for the West Indies to the Director of Public Gardens and Plantations, Jamaica.

Barbados,

21st March, 1901.

DEAR SIR,

By last mail I forwarded for your acceptance about 600 seeds of *Thrinax Morrisii*. I hope these have safely reached you.

2. These seeds were obtained after a good deal of trouble and expense. The original plants have been nearly all destroyed at Anguilla, and it is doubtful whether further seed will be obtained except from one of the Danish islands where the specimen is said to exist very sparingly. There is a handsome specimen of this palm growing at the Botanic Station at Grenada. This is about four to five feet high and in vigorous health. The segments of the palmate leaves are divided almost to the base and this character as well as the rather upright petioles easily distinguishes the species from *Thrinax radiata* and other small palms of this group.

I should be glad to learn of the occurrence of this palm under cultivation elsewhere in the West Indies.

I am, Dear Sir,

Faithfully yours,

D. MORRIS.

DISEASES IN PINE-APPLE PLANTS.

Some diseased pine-apple plants were submitted through Dr. MacDougal of the New York Botanical Garden to Prof. Webber, and the following report was very kindly written on them :—

"The diseased pine-apple, is affected with a malady which we know as blight. While this trouble has not been carefully investigated there seems to be but little doubt that it is caused by a parasitic fungus attacking the roots in a manner similar to that of the *Fusarium* disease which Docter Smith has described as affecting the cotton, melon, squash, ect. The fungus has been traced into the root hairs and thence into the small lateral roots and up into the stem where it frequently causes a blackening and rotting of the tissue. It yet remains to produce the disease by inoculation, however, so we cannot say that the fungus found in such diseased plants is the primary cause of the trouble. The plants affected with the malady first show the symptoms by withering and decay of the tips of the leaves, particularly on the outer row. This gradually continues until all the leaves are affected and the plant is reduced to a mere stump. Frequently the disease goes on for a considerable period, as in the case of the cabbage wilt without causing the death of the plant. Such plants, however, have proved worthless and as they might as well be

dug up and their places supplied with healthy plants. A number of experiments have been tried by various growers working in co-operation with us in digging up the plants when they first begin to show signs of the disease, cutting off the bases above the diseased portions, and then resetting them. This process, however, has not proved satisfactory, some of the plants seeming to recover while others go back again. We have made a few experiments in treating the disease by spraying the bases of the plants and soil with Bordeaux mixture, but results thus far have been entirely negative. At the present time therefore we can only suggest eradication, the taking out of diseased plants as soon as they appear and replacing them with fresh, healthy suckers.

"We are also inclined to think, from the results of a few experiments, that one of the primary ways of controlling this disease is the rigorous selection of healthy plants. By this means we believe the trouble can be entirely overcome."

BERGAMOT ORANGE.

The Bergamot Orange is a well marked variety of the common Orange. The flowers are much smaller with a delicious and peculiar odour; the fruit are somewhat pear-shaped, the rind is of a lemon yellow colour, abounding in essential oil of a peculiar fragrance, and the pulp is greenish.

The cultivation is strongly recommended by Mr. J. Ch. Sawer, Author of "Odoragraphia" for the production of the Oil or Essence of Bergamot. The fruits are used for this purpose when they are full grown but still unripe and greenish. One hundred fruits are said to yield from 2½ to 3 ounces of essential oil.

The principal locality where the Bergamot orange is cultivated is near Reggio in southern Calabria, but it is also grown in Sicily and the South of France.

Low ground near the sea seems to suit it best and the ground is well tilled and irrigated.

Flückiger and Hanbury state that the essential oil "was formerly made like that of lemon by the sponge process, but during the last 20 years this method has been generally superseded by the introduction of a special machine for the extraction of the essential oil. In this machine the fruits are placed in a strong, saucer-like metalic dish, about 10 inches in diameter, having in the centre a raised opening which with the outer edge forms a broad groove or channel; the dish is fitted with a cover of similar form. The inner surface both of the dish and cover is rendered rough by a series of narrow, radiating metal ridges of blades which are about ¼ of an inch high and resemble the backs of knives. The dish is also furnished with some small openings to allow of the outflow of essential oil; and both dish and cover are arranged on a metallic cylinder, placed over a vessel to receive the oil. By a simple arrangement of cog wheels moved by a handle, the cover, which is very heavy, is made to revolve rapidly over the dish, and the fruit lying in the groove between the two is carried round, and at the same time is subjected to the action of the sharp ridges, which, rupturing

the oil vessels, cause the essence to escape, and set it free to flow out by the small openings in the bottom of the dish. The fruits are placed in the machine, 6, 8, or more at a time, according to their size, and subjected to the rotatory action above described for about half a minute, when the machine is stopped, they are removed, and fresh ones substituted. About 7,000 fruits can thus be worked in one of these machines in a day.

"During some weeks after extraction it gradually deposits a quantity of white greasy matter (bergaptene,) which, after having been exhausted as much as possible by pressure, is finally subjected to distilation with water in order to separate the essential oil it still contains.

"The fruits from which the essence has been extracted are submitted to pressure, and the juice which is much inferior in acidity to lemon juice, is concentrated and sold for the manufacture of citric acid. Finally, the residue from which both essence and juice have been removed, is consumed as food by oxen."

The Director of Public Gardens and Plantations was most anxious to introduce this plant into cultivation in Jamaica. Several attempts were made to raise plants from seeds imported from Italy, but none germinated. A few fruits have been obtained through the kindness of Mr. Damman, Seed Merchants of Naples. Each fruit contains only from 1 to 3 or 4 seeds, so that the number of plants available for distribution has been very limited. Twenty plants have lately been sent to the Commissioner, Imperial Department for Agriculture in the W. Indies; others have been distributed to planters in Jamaica; so that it is to be hoped that this very desirable Citrus tree will soon be firmly established throughout the W. Indies, and that fruits will be available on the spot wherever it is found that it succeeds.

A MEDICINAL WEED.

Creat (Andrographis paniculata).

This is a common weed in the Liguanea plain. It is a native of India and Ceylon, and was no doubt originally introduced by means of the Botanic Gardens.

Dr. Watt's in his *Dictionary of Economic Products of India* states that this bitter shrub is well known and forms the principal ingredient of a household medicine extensively used in Bengal. The expressed juice of the leaves, together with certain spices such as cardamoms, cloves, cinnamon, &c., dried in the sun, is made into little globules, which are prescribed for infants to relieve griping, irregular stools, and loss of appetite. The medicinal properties of this plant are many. The roots and leaves are febrifuge, stomachic, tonic, alterative, and anthelmintic. It is used in general debility, in convalescence after fevers, and in advanced stages of dysentery. It is also used as a tonic, stimulant, and gentle aperient in the treatment of several forms of dyspepsia, and in the torpidity of the alimentary canal. The expressed juice of the leaves is a common domestic remedy in the bowel complaints of children. Dose: 1 to 2 ounces of the infusion, and 1 to 4 drachms of the tincture.

Creat belongs to the same family, *Acanthaceæ*, as the common blue flowered "Spirit Leaf."

VANILLA IN SEYCHELLES.

Articles on Vanilla have appeared in Bulletin for October, 1898, with a drawing showing method of pollination and in Bulletins for February, 1896 and March, 1900. The drawing is also reproduced in the Bulletin for June, 1800.

The Administrator of the Seychelles in his Annual Report for 1899, advises that a vanilla plantation should not be started with a smaller capital than £1,000, as a crop cannot be expected under three years. Suitable vanilla land, in Seychelles easily accessible, cannot be purchased under Rs. 300 an acre, and, even at this price, is not readily obtainable. The Crown has there in the hills a few hundred acres of land, suitable for vanilla for lease on terms of nine years, with the option of renewal for a further term of five years.

Under the old system, namely, planting on bars, wires, &c., from 1,200 to 1,300 vines were planted per acre. Vanilla is now planted on live trees, and the number of vines planted depends on the number of trees growing on the land. Cuttings of quick-growing shrubs are now often planted in vacant spots, and after three months vines are then planted on them. Vines are planted six feet long, and will begin to bear three years after planting, but will only reach their prime in three years more. Vines are worth from Rs. 4 to Rs. 8 per 100, according to the district. The wages of men employed on Vanilla plantations vary from Rs. 12 to Rs. 14 a month, and of women from Rs. 6 to Rs. 8, in both cases without rations. Labourers on hill estates are not easy to get, and, as a rule, the African labourers prefer working on moitié or share system. A man can plant 300 cuttings of vines a day, and can keep in good order throughout the year 2,500 plants. Women are employed for pollinating the flowers, *i.e.*, removing the pollen from the anther of the flower and applying it to the stigma, without which operation the flower is lost. No flowers can be pollinated after midday. A woman can pollinate from 600 to 800 flowers per day.

Each vine can produce from 25 to 30 pods of different sizes, from four inches to eight inches long. On an average, 130 green pods go to one lb., of prepared vanilla, the pods shrinking considerably in preparation, and losing a quarter of their weight. The preparation of vanilla has much improved of late years. Sun-drying is no longer in vogue. Nearly all vanilla is now cured in properly constructed drying rooms, heated with hot air. The French method of steaming the freshly-picked vanilla pods has been tried, but the boiling-water process is generlly adopted.

"The local price for vanilla varies. In 1899 fine prepared pods fetched Rs. 16 to Rs. 18 per lb.

"This year the price is from Rs. 14 to Rs. 16. Green pods are now being sold at Rs. 10 per 100 pods.

The regular flowering season is from August to December. The cost of preparation represents from Rs. 1 to Rs. 1.50 per lb. The pods are gathered about nine months after the flowers have been pollinated, and are cured in from three to four months. In Seychelles, as in other vanilla producing countries, there are bad seasons, when owing to excessive rain, the yield of the vine is poor. A present,

the prosperity of Seychelles practically depends on the one product, vanilla. In 1895, for example, the crop almost entirely failed, and the exports were consequently less by Rs 162,335 than they were in 1894. In 1896 the crop was an exceptionally good one, and the exports for that year exceeded the exports for 1895 by no less than Rs. 936,150.

THE PEANUT OIL INDUSTRY.

A general articlr on the peanut or pindar-nut wilf be found in Bulletin for April, 1897, (page 75) in which the expression of oil is noticed, and the use of the resulting cake for cattle food.

The U. States Consul at Marseilles, according to the London *Times*, reporting lately on the peanut oil industry, observes that more oil is extracted in Marseilles from oleaginous seeds than in any other place in Europe, and the industry is beginning to flourish again after the depression produced by the introduction of American cotton-seed oil and the failure of the seed crops elsewhere. As no special machinery or process is employed in the manufacture of peanut oil as distinct from other oil seeds, the manufacturers crush arachides, or peanuts when the market is favourable, but not to the exclusion of other seeds. Last year over 71,000 tons of peanuts reached Marseilles; at Bordeaux a large quantity of West African nuts of good quality is crushed, and there are some mills in the north of France, but Marseilles stands pre-eminent in the industry. The nuts are scarcely ever ground whole, as this produces inferior oil and cake of little value. In fact, a large quantity of the nuts arrives shelled, after which the inner or red skin is removed as much as possible by process resembling those for cleaning wheat in flour mills. These are described in detail in the report. After the kernels have been separated and cleaned they are ground and enveloped in strong fibrous mats, are subjected to hydraulic pressure, and the clarifying of the oil done by means of filters and fuller's earth. The husks are sometimes ground with the cake, and form an inferior food for cattle, and when coal is dear they are used as fuel in the oil mills. The crude oil runs out thick and troubled, and must be filtered to make it a bright yellow, while if it is to be water white in colour it must be treated further with animal black and fuller's earth. It is stated that no alkaline lye is used, but the art is somewhat secret. The sources of supply are Bombay, Mozambique, and Senegal. In some years the African supply is wholly swamped by the supplies from India, and at one time it seemed that Africa would be unable to compete permanently with India. But though the latter still sends large quantities of nuts to Marseilles it appears to be using more and more of its crop at home, so that, while the imports between 1890 and 1895 were mostly from India, in 1896 to 1899 they were mainly from Africa. In the earlier year of the decade American cotton oil menaced the crushing trade of Marseilles with extinction because of its low price, but apparently new demands for oils have arisen, for the production in Marseilles has returned to its former average, and prices also, after serious derangements, have resumed their old level. There has been a world-wide

decrease in the amount of animal grease, while America is consuming her own cotton-seed oils in vastly increased quantities, and the consequence is an increased demand in vegetable oils. Although the production of the nuts in Africa is enormous, no improvement in the mode of cultivation or the price is anticipated for years to come The soil is readily exhausted by the crop, and nothing is done to restore its virtue; labour though cheap, is thriftless, and hard to obtain when wanted, and transportation is defective. The uses of the oil are numerous; it is described as "the most polymorphous of all oils, adapting itself to all purposes, including nutrition, lighting, lubrication, and blending." It is the most difficult of all oils to detect when adulterating olive oil, for its chemical reaction is white. The best qualities are, in fact, used for the table, either pure or mixed with olive or sesame oil; as an illuminant it gives a soft white light; when neutralised it is much esteemed for lubricating, and is always preferred to cotton-seed oil It is also largely used in the manufacture of soap, and is the characteristic component of the famous Marseilles white soap.

CAMOENSIA MAXIMA.

Camoënsia maxima flowered in April, for the first time, in Hope Gardens. It is said to be the largest flower of any plant in the leguminous order; the colour is white, edged with gold.

The first specimens of these flowers found by the botanist Welwitsch, in Africa, were one foot long, but in cultivation they have not attained the same length. The plant flowered for the first time in England in 1894. *Camoënsia* is a climbing plant, a native of Angola. It belongs to the pea family, *Leguminosae*. Welwitsch's specimens were collected in Golungo Alto, a little north of the river Cuanza. Subsequently specimens were sent to Kew from Quiballa, a place situated about sixty miles inland from Ambriz, and from the Congo below Stanley Pool. Welwitsch gave it the name of *Giganthemum scandens* in 1859, and afterwards in 1865 altered it to *Camoënsia* The former name has been adopted in the "Catalogue of Welwitsch's African Plants," by Mr. W. P. Hiern. Welwitsch described it as "a robust shrub, climbing to a great height, and then hanging down its graceful branches, constituting the highest ornament amongst the climbing shrubs of this region; flowers very large, emitting a peculiar odour."

At Hope Gardens it is growing over a calabash tree on the lawn. The flowers measure 10½ inches, from base of sepals to tip of standard. The standard is 7 inches long by 4½ inches broad. The petals are pure white in colour, the edges beautifully crisped, and edged with a line of gold. The standard, in addition, has a deep shading of yellow down the centre, breaking up into small, irregular patches of pure gold near the apex.

The Hope plant produced a raceme of thirteen flowers at first, and afterwards a second raceme of 8 flowers. The flowers expanded first in pairs, then in sets of three, and finally by single blooms. Each flower lasted in full beauty nearly two days. The pods dropped off while quite young.

POTATO DISEASES AND THEIR TREATMENT.

An article on Potato Scab, and remedies for it appeared in Bulletin for June, 1900, (page 87). The following paragraphs deal with various diseases affecting the potato; they were written by Mr. B. T. Galloway, Chief of the Division of Vegetable Physiology and Pathology of the U. S. Department of Agriculture, as a Farmers' Bulletin" (No. 91). As attention is now being paid to the cultivation of potatoes with a view to the export of "new potatoes" to England, it will be advisable to note carefully any signs of disease and to apply the treatment recommended at an early stage.

Potato Leaf Blight, or Early Blight.

(*Alternaria solani* (E. & M.) Sorauer.)

This disease is widespread and destructive. It is confined to the leaves and green stems, and appears about the time the tubers begin to form, but may be noticed earlier if the growth of the plants has been checked in any way. The first indication of its presence is the appearance on the leaves of grayish brown spots, which soon become hard and brittle. The disease progresses rather slowly, the spots gradually becoming larger, especially along the edges of the leaflets. At the end of ten days to two weeks half of the leaf surface may be brown withered, and brittle while the rest is of a yellowish green colour. Three weeks or a month may elapse before all the leaves succumb. The stems in the meantime remain green, but they too finally perish through lack of nourishment The tubers stop growing almost as soon as the leaves are attacked, and as a result the crop is practically worthless.

TREATMENT.

Early blight may be held in check by the application of the fungicide Bordeaux mixture. This is prepared and applied as follows: Pour into a 50-gallon barrel 25 gallons of clean water; then weigh out 6 pounds of crushed bluestone, or copper sulphate, and after tying it in a piece of coarse sacking suspend the package just beneath the surface of the water by means of a string tied to a stick laid across the top of the barrel. In another suitable vessel, such as a tub or half barrel, slack 4 pounds of fresh lime. Slack the lime carefully by pouring on small quantities of water at a time, the object being to obtain as mooth, creamy liquid, free from grit. When the lime is slacked, add sufficient water to make 25 gallons. As soon as the bluestone is dissolved, which will require an hour or more, pour the lime milk and bluestone solutions together, using a separate barrel for the purpose and stirring constantly to effect a thorough mixing. It sometimes happens that sufficient lime is not added, and as a result the foliage may be injured. To be certain that the mixture is safe, hold a steel knife blade in it for two or three minutes and if the polished surface of the blade shows a copper coloured tinge add more lime, but if it stays bright the mixture is safe to use. Application of the mixture should begin when the plants are 4 to 6 inches high. and should be repeated at intervals of twelve to fourteen days until five or six treatments have been made. By adding 8 ounces of Paris green to each barrel of the Bordeaux mixture a combined fungicide and insecticide is obtained, and this will prevent the attacks of the Colorado potato

beetle, the flea beetle, and other insects. Before adding the Paris green it should be mixed with a small quantity of water, and when a thin paste is obtained this should be thoroughly stirred into the barrel of Bordeaux solution.

The success attending the application of the Bordeaux mixture depends in large measure upon the thoroughness with which it is applied. To reach all parts of the plants above ground with a fine spray requiries a good force pump and a suitable nozzle. The knapsack sprayer will be found one of the most useful machines for spraying fields of 3 acres or less. For larger plantations more powerful machines should be used. A cheap and serviceable apparatus, well suited for this work, may be made by mounting a good, strong force pump on a barrel, and then placing the barrel and mounted pump in a light wagon. The entire outfit, including barrel, pump, hose, nozzles, operator, and boy to drive, may be drawn by one horse. As the wagon is drawn slowly between the rows the man in the wagon may operate the pump and at the same time keep the mixture stirred, while two others on the ground hold the nozzles and direct the spray over the plants. The nozzle found to be the best suited to the work is the Vermorel. This is now offered for sale by pump manufacturers and dealers in seeds and agricultural implements. Where there are only a few plants to treat, simple devices for the application of the fungicide, such as watering cans, the syringes used by florists, etc., may be used.

Potato Blight, Late Blight, or Rot.

(*Phytophthora infestans* (Mont.) de Bary.)

This disease attacks the leaves, stems and tubers. Generally the first noticable effect upon the leaves is the sudden appearance of brownish or blackish areas, which soon become soft and foul smelling. So sudden is the appearance of the disease in some cases, that fields which one day look green and healthy may within the next day or two become blackened as though swept by fire. The rapid spread of the disease, which is caused by a parasitic fungus, is dependent in large measure upon certain conditions of moisture and heat A daily mean or normal temperature of from 72° to 74° F. for any considerable time, accompanied by moist weather, furnishes the best conditions for the spread of the parasite. On the other hand, if the daily mean or normal temperature exceeds 77° for a few days, the development of the disease is checked. This fact explains why the fungus seldom occurs to any serious extent in sections where the mean or normal daily temperature exceeds 77° for any length of time, and probably why it appears later than the disease discussed under the former heading. The tubers affected with the disease show depressed, dark-coloured areas on the surface, while within are blotches and streaks of a brownish or blackish colour. Other diseases may produce similar effects, so that in this case the changes are not so characteristic as those shown by the leaves. For many years it was believed that most of the injury to the potato was due to this disease, but recent investigations have shown that view to be erroneous.

TREATMENT.

The same treatment as recommended for early blight should be followed here, and will be found to prevent the blighting of the tops and

rotting of the tubers. In regions where late blight is known to occur, care should be taken to begin the application of the Bordeaux mixture before the attacks of the fungus. In all this work it must be constantly kept in mind that the main object is prevention rather than cure. Benefit will undoubtedly result if only clean, healthy potatoes are used as seed. Decayed and discoloured tubers should be fed to the hogs, as it is poor policy to plant them.

Brown Rot.

(*Bacillus solanacearum* Smith).

This disease occurs in many parts of the South, and, in addition to attacking the potato, is found to seriously injure eggplants and tomatoes. In the case of the potato, the leaves, stems, and tubers are affected. The diseases usually manifests itself by a sudden wilting of the foliage and soon the whole plant may become affected, the leaves and stems shrivelling and then turning brown or black. The disease reaches the tubers through the stems, producing a brown or black discolouration of the tissues and ultimately a complete breaking down or rotting of all the parts. Brown rot is caused by a bacillus, a minute organism, which multiplies in the tissues and through its action produces the effects mentioned. Various insects, such as Colorado beetles, flea beetles, and blister beetles, serve as carriers of the disease. These insects may feed on a diseased plant, and in their visits to adjoining healthy ones infect the tissues through bites and possibly in other ways.

TREATMENT.

Throughout the South, namely, in South Carolina, Mississippi, Alabama, and adjacent States where this disease is known to occur, a thorough system of spraying, such as recommended for early blight, should be followed. In addition, all diseased vines should be removed and destroyed as soon as possible, and the tubers should be dug and either used at once or stored in a cool, dry place. In planting it would be well to avoid land which has just been used for tomatoes or eggplants, and finally seed tubers from localities where the disease is absent should be used if practicable.

Potato Scab.

(*Oospora scabies* Thaxter.)

Scab is one of the most widespread diseases affecting the potato. Injuries of various kinds may produce a roughened surface, but it is safe to say that most of what is known as scab is due to the attacks of a minute parasitic fungus, first studied and described by Dr. Roland Thaxter, of Harvard University.

TREATMENT.

Potato scab may be successfully controlled by treating the seed previous to planting. Two fungicides are used for the purpose, namely, corrosive sublimate solution and formalin solution. To prepare the first, dissolve 2½ ounces of corrosive sublimate, or bichloride of mercury, in about 2 gallons of hot water and after ten or twelve hours dilute with clear water so that the whole quantity makes 15 gallons. Corrosive sublimate is a poison and must therefore not be placed where

it can fall into the hands of children or irresponsible persons. To prepare the formalin solution, mix 8 fluid ounces of commercial formalin (otherwise known as 40 per cent formic aldehyde) with 15 gallons of water.

To treat the potatoes with the corrosive sublimate solution, immerse them for an hour and a half in the liquid and then spread out to dry. Finally cut and plant in the usual manner. A large barrel is a convenient receptacle for the solution. The potatoes may be placed in a coarse sack and suspended in the liquid, care being taken to wash the tubers before dipping, provided they are very dirty. All treated tubers should be planted in order to avoid danger from the poison upon them.

It has been shown that the formalin is fully as effective against scab as the corrosive sublimate solution. and as it is far less dangerous it will probably come into more general use. In treating seed with this preparation the whole potato should be soaked for two hours in the solution already described. After soaking, the potatoes may be dried, cut, and planted in the usual way, care being taken not to allow them to become contaminated by coming in contact with bags, boxes, or bins where scabby potatoes have been kept. In practice it is found that 15 gallons of either of the foregoing solutions will be sufficient to treat 20 to 25 bushels of potatoes, taking ordinary precautions of course not to waste too much of the fluid as each lot of tubers is dipped.

Tip Burn, Leaf Burn, or Scald.

This disease of the leaves occurs in many parts of the country and is often confused with early blight. The tips and edges of the leaves turn brown and these discolored areas soon become hard and brittle.

The burning or scalding may occur at any time and as a rule is the result of unfavourable conditions surrounding the plant. Long-continued cloudy and damp weather followed by several hot and bright days is very apt to result in the burning of the foliage. This is especially the case on soils carrying a comparatively small percentage of moisture. When the weather is cloudy and damp the tissues of the potato become gorged with water and this has a tendency to weaken them. If the sun appears bright and hot when the leaves are in this condition, there is a rapid evaporation of the moisture stored up in their cells. The evaporation may be faster than the supply furnished by the roots, and if this continues for any length of time the weaker and more tender parts first collapse, then die, and finally turn brown and dry up. Tip burn may also occur as the result of protracted dry weather.

TREATMENT.

Little of a specific nature can be said on the treatment of this trouble. Numerous factors are involved in the matter, so that only general statements are possible. Every effort should be made to keep the plants in good growing condition, for if they become checked through lack of proper food or cultivation or both they are more apt to burn. It is a fact that where the Bordeaux mixture is used for other diseases burn is less apt to occur, and this furnishes another instance of the remarkable properties of the fungicide. Briefly, therefore, the plants should be kept as vigorous as possible by good cultivation, plenty of available food, and the application of Bordeaux mixture, as recommended for early blight.

Arsenical Poisoning of Potato Leaves.

In many sections where Paris green in water is applied to potatoes injuries are produced which can not be distinguished from early blight by any ordinary examination. It frequently happens, therefore, that farmers are led to believe that their potatoes are affected with early blight and other diseases when the trouble has been brought on by themselves through the improper use of Paris green. Injuries resulting from the use of this substance are very apt to occur where flea beetles have eaten the foliage. The arsenic attacks the tissues at such points, and as a result more or less circular brown spots are produced, having for their centres the holes eaten out by the flea beetles. By combining the Paris green with Bordeaux mixture, as already described, these injuries may be wholly avoided.

Concluding Remarks.

The cost of the work of spraying as described here will depend to a conderable extent upon the kind of machinery used and the price paid for labour. With suitable apparatus and labour at $1 50 per day, potatoes may be sprayed six times for about $6 per acre. This estimate is based upon experiments extending over several years and includes the cost of chemicals as well as labour. The cost of treating scab is mainly in the labour involved in dipping and drying the seed and seldom exceeds 15 cents per acre. Much attention has been given to the effects of Bordeaux mixture on the growth and yield of potatoes aside from its value in keeping parasitic foes in check. It has been shown conclusively that it pays to apply this preparation if for no other purpose than to induce a more vigorous growth. Three or four applications of the mixture have in many cases increased the yield of potatoes 50 per cent, so that no matt r where the crop is grown or whether diseases are present or not the writer feels warranted in recommending the application of the mixture on the ground that its use will yield a handsome return.

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Nymphæa stellata var. cyanea,

From Dr Pittier, San Jose, Costa Rica.

Castilloa Tuna.

Cedrela sp. (Bitter Cedar—From 600 to 3,000 ft. elevation above the sea-level, on Pacific Slope, Costa Rica).

Cedrela montana (Sweet Cedar—on both slopes, from 200 to 4,000 ft. above sea-level in Costa Rica).

Tabebuia rosea, (Red Savanna Oak—Pacific Slope, from 300 to 3,000 ft. above sea-level).

From Director Botanic Gardens, Buenos Aires—

Amaryllis nivea; Cocos Yatay; Crinum ornatum; Cunninghamia; sinensis; Cupressus funebris; Hippeastrum reginæ; Littonia modesta; Machærium Tipu; Pinus canariensis; Thuia gigantea; Tritoma Uvaria.

From Curator, Botanic Gardens, Ootacamund—

Acacia armata; A. dealbata; A. decurrens; A. melanoxylon; Acrocarpus fraxinifolia; Berberis nepalensis var. Leschenaultii; Elettaria Cardamomum; Chamærops Fortunei; Cupressus torulosa; Clematis Zouriana; Erigeron alpinus, var. Wightii; Eucalyptus citriodora; E. corymbosa; E. Globulus; E. piperita; Exacum bicolor; Flemingia Grahamiana; Grevillea robusta; Knoxia corymbosa; Lasiosiphon eriocephalus; Lilium neilgherrense; Litsea zeylanica; Ligustrum neilgherrense; Mandevilla suaveolens; Manihot Glaziovii; Meliosma Arnottiana; Michelia nilagirica; Peduncularis zeylanica; Phœnix rupicola; Pinus longifolia; Rosa gigantea.

From The Cremorne Nursery, Co., Richmond, Victoria, Australia—

Eucalyptus citriodora; E. robusta; E. saligna.

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Nymphæa Lotus; Nymphæa Lotus, var. rubra.

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Cooperia pedunculata; Gelasine azurea; Zephyranthes Andersoniana; Z. carinata.

HERBARIUM.

From Rev. J. P. Hall, Retreat Pen, Brown's Town—

Cæsalpinia Sappan.

From Mrs. Cradwick, Half-way Tree—

Sp. of Fungus.

From R. K. Tomlinson, Esq., Lacovia—

Hiræa Simsiana.

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JAMAICA.

BULLETIN

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New Series.] JULY, 1901. Vol. VIII. Part 7.

CURING AND PACKING PRODUCE.

By C. E. deMercado.

Mr. Charles DeMercado gave a lecture last year to the teachers undergoing a course of agricultural training at Hope His subject was the curing and packing of Island produce. He kindly promised to revise the lecture as published by the "Gleaner," but time and opportunity have been wanting, and it is felt that it would be a pity to delay any longer its appearance in the bulletin.

Mr. DeMercado said it gave him a great deal of pleasure to address his audience, not only about the proper methods of curing and preparing Jamaican products for foreign markets, but also for home consumption. We still had a great deal to learn about properly supplying our own local markets; there were a lot of little points in that connection which might be very profitably studied by agriculturists. His hearers had been brought together to receive instruction in proper agricultural methods, but it was as important to know what to do with the crops after they were grown as to know how to grow them. No crops were produced in Jamaica which did not have to undergo some process of preparation for the market after they were grown, and it was at that very point that most people failed. It was not enough to grow the stuff; it must be put upon the market whether home or foreign, in the form most acceptable to the market, so that the best price might be obtained. In Jamaica there could be no doubt that we depended entirely for our wealth upon agriculture, and his hearers would therefore be doing the greatest good to the country if they would impress upon those over whom they had influence the paramount necessity of placing agriculture upon a proper basis There was no other field of employment in Jamaica which offered such prospects of wealth to a man as agriculture, none which conduced so much to the prosperity of the country. That was why he had taken so much interest in the subject, and had always contended that it was the most important which the Government could take up. The merchants knew very well that they were not of so much importance to the country—though they were a necessary go-between—as those who added to its wealth by agriculture.

His business was to speak of the curing and packing of produce. The first great essential in handling any crop was absolute cleanliness. Many products depended very largely for their selling price upon their aroma, which would be lost if any dirt or rubbish were mixed with them. Therefore, all storehouses, barbecues, packages, etc., should be kept scrupulously clean. He sometimes heard it said that people did not trouble to cure their produce well because they found that the same prices were paid for good and bad produce coming from the same district. It might happen that a merchant bought a large quantity of badly-cured coffee from a district, together with a few pounds well cured. The small parcel of good stuff was of no us to him ; he could not sell it separately, and it therefore had to go in with the inferior stuff. It would thus be seen that a man who cured his produce badly harmed his neighbours as well as himself, and helped to get his district a bad name. Co-operation among the people could do a great deal to remove this danger and get a good reputation for a district. The commercial world was constantly disturbed by over-production, but very seldom indeed did it witness over-production of the best qualities of goods. If a man had a specialty that was really good, he could readily find a good market for it. They saw that in the case of coffee; when the price of the product dropped it affected the inferior qualities very seriously indeed, but the price of Blue Mountain coffee had practically not been affected at all. It was as high to-day as ever. He desired to make his remarks specially applicable to small settlers, and it might at first sight seem impossible for that class to reach the same degree of agricultural perfection with their products as large cultivators with plenty of capital at their command. But while absolutely the same degree of perfection might perhaps not be reached, it was yet within the power of the small cultivator to attain very nearly to it by means of co-operation. In the case of coffee, the peasant proprietor was in the same position as the largest proprietor—nay, he was even in a better position, for on account of the smaller extent of his operations he could give much closer personal supervision to the details. One of the essential features of good coffee was to secure a large bean. That was to be arrived at by attention to proper pruning and manuring. It might be urged that the rich man could buy manures and the poor man could not, but his hearers were being taught by their instructors that proper manures lay ready to the hand of the small settler, and were to be had for a little time and trouble. The system of curing coffee followed for the most part in the lowlands of Jamaica—which produced what was known as "double-husk" coffee—was quite wrong, and ought to be improved without delay if Jamaica was to successfully compete with her rivals. A very important point was only to pick each day such berries as were quite fit. The plantation should be gone through contantly, for this purpose; people should not through pure laziness, want to pick a lot of berries at once, whether fit or not. After a start had been made to dry the coffee, it should never be allowed to get wet again under any circumstances. The "double-husk" method was to dry the coffee in the berry. That was a bad system, because it produced coffee which was poor in quality, discoloured, and deficient in aroma. It was much better to pulp the berries, but of course many settlers had no

pulper and could not afford to buy one, and therefore had to dry the coffee in the husk Coffee was a product which very quickly took up any external odour, dirt or impurity. If it was to be cured in the double husk, it should never be allowed to lie on the ground, as was very often the case. Frequently care was not even taken to sweep the place clean, and the coffee consequently soaked up all the manifold impurities of the soil, and was ruined. They must remember that the buyer abroad not only inspected the coffee he bought and judged of its aroma but actually ground, roasted, and tasted it. If the small settler did not own a barbecue let him place his coffee upon a clean board, but not on the bare ground, and let him take care that nothing foul got mixed up with it. Besides the "double husked" and "washed" coffee prepared with the pulper, there was a third system by which some of the coffee was washed and some was not. That was to say, the pulping was improperly done, and the coffee was taken to the merchant with half of it washed and half unwashed. Of course, the result was that the inferior article lowered the value of the good article, and the unwashed destroyed the value of the washed.

To illustrate his remarks, Mr. DeMercado handed round three samples of coffee, all from similar cultivations in the same district the only differences being in curing. The first specimen was bad "double husk" coffee, the second a better quality "double husk," and the third "washed" coffee. The prices in the London market were 40s. per cwt. for the first, 45s. for the second, and 60s. for the third. Proceeding with his lecture, Mr. DeMercado pointed out that it was only by properly pulping the coffee that the best price could be obtained. The pulper was not very expensive to buy, and if there were only a little co-operation there might be one among every group of small settlers. All that was necessary was for a few men to make up their minds to help themselves and help each other at the same time. Each man could send his coffee to the common pulper, and realize a much better price on his crop. In many districts of the Island to-day such small central factories were run by merchants who bought the coffee in the cherry and cured it themselves. He warned Jamaicans that unless they produced better coffee they were likely to see still lower prices. Brazil, their powerful rivel in the coffee market, used to turn out the product by the primitive "double husk," method but in recent years the cultivators in that country had seen the error of their ways, and had taken to pulping and washing, with the result that our unwashed coffee was being to a certain extent neglected in the market.

Mr. DeMercado showed a sample of Blue Mountain coffee to illustrate its superiority to the lowland product. He urged those of his hearers who came from coffee districts to tell the small settlers to use a little patience and not pick the unripe berries. The coffee having been cured, he proceeded, they came to the point of packing it in the bag to send to the shipper. Here there was room for great improvement—and his remarks on this head applied to the shopkeeper as much as to the grower. He had in his office a museum of foreign substances found in bags of coffee sent to his firm. Among them were such things as pumpkins, a pair of baby's shoes, a chisel, a hammer-head, empty

tins, several boots, and in fact pretty nearly every known article in the world. This was the result of gross carelessness. The people who packed the bags at the country shops were not dishonest; they simply let them lie about open, and when the emptied, say, a tin of condensed milk, it was the most natural thing in the world to throw it into the coffee bag, and perhaps the opener as well. Experience had taught him that he dare not send away coffee without repacking it, or the people with whom he did business abroad would think he was not a honest man, and would write to tell him that when they wanted to buy hammers and chisels they would prefer to go to the hardware store.

Turning to the subject of cocoa, Mr. DeMercado said it was a product of comparatively recent date in Jamaica, or rather a revival. When the Island was first occupied by the Spaniards they found cocoa growing, and they kept up the cultivation for many years, until eventually it died out from want of care. He came across a curious legend about it in an old book the other day. As his hearers perhaps knew, there was a worm which attacked the tap root of the cocoa plant and proved very destructive if not guarded against. The old Spaniards told the first English settlers that when the Indians planted cocoa they held a religious ceremony and poured a libation to their gods over each plant, which had the effect of rendering it immune from this worm. Of course, people were too sensible to believe that sort of thing now a days, and they could keep the worm away without libations. He could thoroughly recommend the planting of cocoa in Jamaica provided the district was suitable. It could be easily cured with a little attention and care and the small proprietor could reach a level of excellence almost equal to that of the large grower. Cocoa was one of the products Jamaica had improved herself in of recent years. She used to be much behind Trinidad, but now she was almost up to her. The house and the implements used by the large grower could be easily imitated by the small man. After the cocoa had been gathered when in a fit state, the pods should be kept in a dry place for some days. The pod should then be broken and the cocoa-beams taken out with the mucilage adhering to them, and put in a box with holes in the bottom and sides to allow of the mucilage running off during sweating. Plantain or banana leaves should be packed on top to help the sweating. The longer the process of sweating the better. Three or four days would probably be long enough in most cases. The cocoa beans should be changed from box to box several times during the process so that all parts of the heap would have a chance of equal fermentation by being shifted from the middle to the top or bottom. Then the cocoa should be put in the sun and spread out very thin. In Trinidad coolies walked over the cocoa in this state with bare feet to take up the mucilage, but this must not be done after it was partially dry or it would break the beans. The period of drying depended upon the heat of the sun, but it must be carried to such a point that the bean would break easily and the skin would leave the bean without being brittle. By this simple method, if properly carried out, the small settler could get cocoa that would prove readily marketable and fetch a very good price indeed. Mr. DeMercado exhibited a sample of small settlers' cocoa from St. Andrew and Linstead improperly fermented

and sweated, and therefore only worth 70s. per cwt. in the London Market. A properly cured small settlers' sample from St. Mary, worth 72s. or 73s. was also shown; and a sample of the best quality, worth 78s. The evaporation process, he explained, was hardly practicable for small settlers unless by co-operation. The man who cured his cocoa properly not only got a better price than the man who did it badly, but actually got more weight from the same number of beans because some of the mucilage dried on to the bean.

There was such a thing, the lecturer proceeded, as a product being absolutely valueless if it was a little "off" in quality and yet fetching a fair price if it was well prepared. This was the case with anatta. This product grew wild in Jamaica and yet had a very small market. It was used for colouring butter and cheese, but chemical substances had been discovered which did this, and so anatta had gone to the wall to a large extent and poor anatta was quite unsaleable—nobody would have it as a gift. Yet good anatta could still be sold. If good anatta could be sold at a high price, there would be some room for the poorer quality at a low price, but the good being down, the bad was nowhere. Eight or nine shillings a hundred weight could be got for the good article to-day. The cause of the difference in the quality was simply improper curing Anatta should not be cured in the sun, but in a shady place with plenty of draught. It would thus dry properly without losing any of the colouring matter through evaporation by the sun's rays Good anatta was moist after curing and could be squeezed up in a ball in the fingers. The bad quality lost its fine red colouring and went dark. A mark of all properly cured produce was that it never got hot or fermented in the bag. He had taken up the question of anatta simply to impress upon his hearers the great commercial truth that even with the very worst condition of the market there was some demand for the good article, but there was no hope for the bad.

Turning to pimento, the lecturer remarked that it was a gift of God to the Island. Practically speaking, we had it to ourselves; we did not have to grow it, and the least we could do was to send it to market in a fit condition. After it was picked it should go through a process of sweating. It should be heaped and covered with plantain leaves or banana thrash, which would help to protect it from the rain. Great care should be taken that it did not get wet. After the sweating process, it should be placed on thoroughly clean barbecues to dry. At this stage its colour should be a sort of reddish brown, if it had been properly sweated. Care should be taken that it was thoroughly dry before it was put up, and it should be fanned. Every man, perhaps, could not buy a fan, but here again co-operation could come in usefully. The difference in price for one crop would pay for the fan, which he believed only cost £5 or £6. Imperfectly cured pimento would ferment and get hot in the bag, and lose enormously in weight. A man might buy 100 lbs. and in a few days find the weight drop to 85. How could they expect a merchant to give a good price when he was buying a pig in a poke of this kind? Well-cured pimento, on the other hand, only lost slightly in weight in shipment. In regard to sweating, a great deal depended on conditions and apparatus. Care must be taken, as with cocoa, to sweat all parts of the heap equally.

Pimento should be picked in the green state, which was really the unripe state.

Turning to fruits, Mr. DeMercado said his remarks would apply equally whether the articles were intended for export or for the local markets. If produce such as pimento and coffee, which would stand all sorts of hard usage, had nevertheless to be treated most carefully, how much more so must perishable fruits, for only then could it possibly be profitable to export. The care taken must commence, in the case of oranges and other citrus fruits, with the picking from the tree. That should be done with a sharp knife or pair of scissors, and part of the stalk should be preserved adhering to the orange. One imperfect orange in a barrel would contaminate the whole barrel—nay more, given time it would contaminate every fruit in a large room full of oranges. In picking, each orange should be tenderly handled, placed gently in a basket or other receptacle, and carried to the house or shed where it was to be packed. Oranges should never be packed immediately after picking. They should be spread out as openly as possible in an airy room and allowed to dry, say for twenty-four hours or longer. During this time they should be gone over and every orange examined, and any showing the least sign of deterioration thrown away—not into a barrel in the same room, or close by, but as far away as possible. The reason for curing oranges, so to speak, was that very often defects could not be seen when they were taken from the tree, but developed plainly in a few hours. Then came the question of packing. This was the crucial point. A man should not think that because he managed to sell a lot of bad oranges once he had done a good thing. His mark would be known, and dealers would fight shy of his exports in future. Furthermore, he would help to give the Island produce a bad name, and damage his neighbours. Such a man was an enemy to the community. It was not with oranges as with pimento that we had the market to ourselves. If Jamaica oranges got a bad name, there were plenty of competitors to profit by our loss of reputation, and the man who packed poor fruit was helping to ruin not only himself, but every other orange grower in the Island. The good suffered for the bad. It often happened that a man did not pack his own fruit. In that case he should take the utmost care in conveying it to the local market at which he sold. There was no reason why oranges intended for local consumption should not be picked with the leaves and stalk on. It would make them look much more attractive, they would keep better, and they would sell better.

With regard to bananas, he could not say much. The export of that product was only carried on by large concerns, but he urged his hearers to impress upon small settlers the need of carrying their bunches of bananas to the wharf as carefully as if they were babies. Here again, Jamaica had plenty of competitors, but if we got a good reputation for our bananas other places would find it all the harder to take away the markets which had been ours so long. If on the other hand we delivered bananas in a worse condition then those from Port Limon and other places we should naturally suffer.

The teachers could do much to impress these truths upon the people and thereby increase the wealth of the country and improve social con-

ditions. Their influence commenced with the child, and if they instilled into him proper ideas on these subjects they would do the country infinite service. It was neither necessary nor practicable that all his hearers should become scientific agriculturists, or that they should all turn practical agriculturists out of their schools but they would be able by reason of the training they were now receiving, to direct the minds of the children into channels that would prove for their good. Everybody was contributing to the cost of education, and it therefore behoved them to see that the schools turned out men and women who would be useful to themselves and to the community. There was not room in Jamaica for another five thousand teachers, or another five thousand lawyers, or another five thousand doctors; neither was there room for another twenty thousand shopkeepers—it would mean ruin to those who embarked in those lines; but if the people would recognize that the soil was the source of wealth there was plenty of room for five million agriculturists, and in saying that he would ask them what degree of prosperity a man could arrive at by school teaching. They must know pretty well. If the country had a big surplus of lawyers and doctors, lawyers' letters would go begging at a farthing a piece, and doctors' visits would be had for nothing. But in agriculture Jamaica had the whole world for her field. Here peasants had been living in the past from hand to mouth; they had been satisfied to plant what was known as "catch crops," with the natural consequence that often they had nothing to depend on. The teachers should instil into them the necessity for planting permanent crops, such as oranges, coffee, and cocoa. Every man who planted a tree which produced something did a service to his kind which could not be too highly extolled. He was not an agriculturist himself, but he claimed that he did know something about the needs of the country and about what people wanted abroad. And one thing he knew was that, to use an Americanism, Jamaica was not "the only pebble on the beach." If she did not send her products to the markets in a proper condition she would lose those markets.

A vote of thanks was very heartily accorded to Mr. DeMercado.

Responding, he said that what he was proudest of in his brief political career was the fact that through his instigation and suggestions to the Government the present steps in the matter of agricultural education had been made. All the time he was in the Legislative Council he endeavoured to direct the attention of his fellow-members and of the country to that matter, and he was very happy to know that through the resolution which he was able to carry the present Board of Agriculture had come into being. It had been a real pleasure to him to give a little instruction on a subject with which he could claim familiarity. Jamaica was his home, and if from the force of circumstances he was in a position to assist his fellow Jamaicans it was a question of duty with him. No greater assistance could be given the people than by helping them to find means of livelihood and avenues of prosperity for the growing population. He had given thought and attention for several years to these matters. It was sometimes said, when a man who did not till the soil told the people to do so, that he was trying to "keep them down." Personally, he always felt that he would much rather be an agriculturist than a merchant, but one could

not always be what one wanted. A man who wished to gather wealth in Jamaica had got to look to the soil for it. So far from degrading a people, agriculture was an ennobling pursuit. Nothing gave him greater pleasure than to see a plant or tree which he had grown himself coming up properly. There were some people who wanted to see practical and definite results already from the work of the new Board of Agriculture. Well, nothing could be done with such unreasonable people. He should be satisfied if he saw some results when his steps were tottering and his hair was white. He urged the teachers to tell the people to write to the Board whenever they wanted any agricultural advice. Applicants would receive speedy replies, and if enough people were interested in the matter, Mr. Cradwick would be sent down to do what he could for them. Of course, if Mr. John Jones thought he would like to grow coffee, the Board could hardly oblige him by sending down a lecturer for his individual benefit, but the Board existed to do all it could in reason to help agriculturists. All they wanted was for the people to avail themselves of the facilities it offered. There was one other matter he ought to touch on, and that was the question of prices. It was no good to stop growing a product because prices fell. Sir Henry Blake told the people to grow ginger, which was fetching a very high price in his day. They did so, and ginger was not fetching such a good price now. That could not be helped, and the only thing to do was to adapt one's self to conditions. When the great falls took place in the prices of sugar and wheat it was said that it would be sheer ruin to grow. But sugar and wheat were still grown at even lower prices and somehow managed to pay. He remembered the time when people said it would be ruinous to grow sugar at £15 a ton. It was being produced to-day for £9 a ton, and with better cultivation and improved methods it could be turned out for £6 a ton. When prices fell, the grower must accommodate himself to conditions by improving his agriculture, by making an acre yield perhaps double what it did before, and by putting his produce in the market in the best possible form. If Jamaica gave up sugar because prices fell, and then coffee, and oranges, and perhaps later on bananas, goodness only knew where it would all end. Presently we should be exporting nothing and all living on roots.

IMPERFECT COCO-NUTS.

Coco-nuts have been sent to the Director from a correspondent in St. Elizabeth of an abnormal character, the husk only being developed without any nut: they were sent on to be examined by Dr. MacDougal, Director of the Laboratories in the New York Botanical Garden, and the following letter and report has been received:—

Dr. MacDougal to Director of Public Gardens and Plantations.

New York Botanical Garden,
Bronx Park, New York City,
April 11th, 1901.

Dear Sir,

Replying to yours of March 26th, referring to some imperfect coco-nuts sent to us for examination on same date, I beg to submit the en-

closed report on same made by Miss E. M. Kupfer. As you will see from this report, the fruits are not diseased in any manner, but the non-development of the nut must be due to the fact that pollination is not effected. This may result from the destruction of the pollen in the flowers by animal or vegetable parasites, or perhaps something interferes with the usual agent active in transferring the pollen from the stamens to the pistils An examination of the living plant will be necessary to determine this. These imperfect fruits are interesting examples of the development of the accessory parts of a fruit with no formation of seed, as may also be seen in two or three species of the banana.

Yours very truly

D. T. MacDougal.

Director of the Laboratories.

Report on Imperfect Coconuts Received from Director of Public Gardens and Plantations of Jamaica.

One of these coco-nut fruits of average size, was found to weigh 575 grams. For comparison a coco-nut of about the same dimensions was taken which had been lying for a year in a dark room and which, but for a certain loss in weight by the drying up of the milk and the "meat," might be considered normal. This fruit weighed 880 grams, making a difference of 305 grams in favour of the normal specimen. If the latter had been fresh, the difference, would, of course, have been still more striking.

The husks of both were then sawn open longitudinally and the contents of the fruit compared. Nowhere, in the abnormal fruit could any indication of seed be found. The locule was almost entirely overgrown with the woody fibres of which the husk is composed, so that, at first sight, the section showed nothing but a solid mass of this fibrous tissue. Upon closer examination however, a shallow irregular, narrow cavity, excentrically placed was discovered in one half of the fruit. It was 15 cm. long, 2.5 cm. wide and 3 cm. deep. In this there were three centers about which small quantity of shell substance had begun to form. One of these regions was situated at the chalazal portion of the seed, one on the floor, and the other directly above it on the roof of the cavity. In each case the region so hardened was more or less tubular, and did not exceed an inch in length, ½ inch in width, and ½ inch in thickness. A microchemical comparison of this shell substance and that from the perfect fruit revealed no differences. Both were found to be largely composed of highly lignified cells, containing, in some instances, oil drops.

A certain differentation of the husk substance, noticeable in the normal fruit, was absent in the abnormal one. The husk is made up, as was marked before, of woody fibres. Each fibre is surmounted by a quantity of loose pith so that the appearance of the material is decidedly spongy. In the healthy fruit, there is at the basal portion, at the micropylar end, a felt of much looser fibres very different from the general mass. They are finer and more pliant, and are not surrounded by pith. The mass of finer fibres may serve to absorb and retain moisture for the benefit of the embryo and seedling. There is also a layer

of exceedingly tough, coarse strands, which will stand a considerable amount of strain, attaching the nut to the husk. Neither of these specialized fibres was to be found in the sterile nut. A microscopical examination disclosed no important differences in the bast cells which make up any of the strands of either the perfect or the abnormal husk. The difference in the relative thickness and stiffness seems entirely due to the number of cells in a strand.

In order to determine just what proportion nut and husk had in the normal fruit, the nut was removed and the husk weighed. It was found to weigh exactly half of the original amount, or 400 grams. The other fruit, which was approximately the same size, weighed, as noted above, 575 grams, the average of fresh specimens being about 610 grams. So that it would seem as if some of the substance which would usually go to the formation of seed was here devoted to increasing the bulk of husk.

Since no trace of fungus, insect, or bacterial activity could be found, no direct evidence as to the cause of the condition of the defective fruits could be produced. The probability is, however, that the responsibility for this state of the fruiting organs is to be laid to none of these agents, but is the result of the failure on the part of the flower to effect pollination. Such failure seems to be more or less common and well known, as is evident from the following statement from the Cyclopedia of American Horticulture (L. H. Bailey Vol. 1. p. 342:) "Coco-nuts, like many other fruits, often grow to a considerable size without pollination, and then perish."

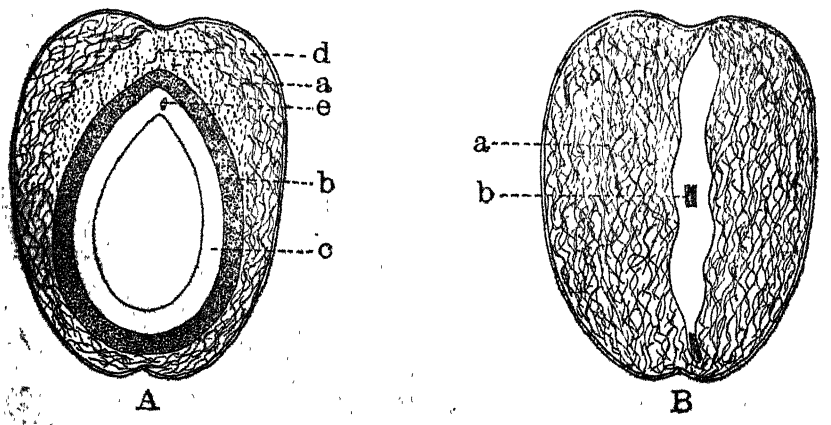
An examination of the pistils and stamens of the trees, producing these fruits with regard to the method of pollination would probably afford an explanation of the absence of seed in the specimens under consideration.

A diagram showing the relative extent of the tissues in the two fruits is appended.

E. M. KUPFER

Explanation of Figures : A. Normal, B. Sterile Fruit :

a. husk fibres ; b. shell ; c. endosperm ; d. finer fibres around micropyle ; e. embryo.



FOOT ROT.

This Diseases is also known as "Collar Rot" and "Mal di Gomma." The English names refer to the place in the tree attacked,—the lower portion of the stem next the ground, and the upper portion of the root just below the surface. The Italian name refers to the formation of gum which is the usual accompaniment of the disease.

The bark decays at the collar, gumming takes place with a disagreable odour, the leaves look unhealthy, and of a sickly, yellow colour, the small shoots die off, and the fruit sets abnormally thick. The decay of the bark extends to the main roots and round the stem; this process is assisted by the attacks of ants. When it has completely girdled the tree, death follows.

There are several conditions which may be considered as rendering the tree liable to "foot rot," but the disease itself is supposed to be a minute fungus.

Observation has shown that the disease is most common where any of the following conditions exist: Improper drainage; planting the trees so close together that the ground is continually shaded and kept moist; continuous use of organic fertilisers; excessive cultivation; continuous excessive irrigation which keeps the soil water-soaked; and deep planting.

The manner in which the disease spreads, appearing at different dates first in one country and then in another, and extending gradually from grove to grove, strongly indicates that it is contagious, being caused or at least greatly aggravated by some parasitic organism. It is thought by many to result from the attacks of some parasitic organism, and Professor Briosi describes and names a fungus *Fusisporium limoni* which he finds always accompanying the disease. He is inclined to consider the fungus the cause of the trouble, but is in doubt as to whether it is the primary cause. He says, however: "I do not believe there can be any doubt that its presence accelerates the disorganization of the tissues and aids in extending the disease."

The following letter shows that the disease can be combated with success.

Hon. Oscar Marescaux to Director, Public Gardens and Plantations.

Cherry Garden, Jamaica,
20th May, 1901.

Dear Mr. Fawcett,

Some time ago in reply to my enquiry you were good enough to give me the following receipt for keeping off the black ants from eating the peel of my orange trees just where they come out of the ground:—

2 lbs. common clay dissolved in water to the consistency of ordinary paint,
2 lbs. flour of brimstone properly mixed in same,
A small piece (say a good table-spoonful) of Soft Soap,
A couple of spoonfuls of ordinary kerosine oil—
to be applied with a brush at the foot of the tree.

Besides using this mixture for the above purpose, I have caused some of my trees which were covered with the white scale to be painted

with it—and the effect in both cases is so good that I hope you will recommend the use of this very simple remedy to those who suffer from these pests.

I should mention that most of my trees are about 4 years old,—that the ants during the dry weather, and probably to get some moisture, used to attack the stem where it emerges from the ground—leaving a nasty scar which the new peel has to cover up—but now they have left off their depredations.

The white scale is mostly on the branches, and my men do not find it difficult—with the aid of a brush they make themselves out of a banana or a "korato"—to coat them thoroughly with the mixture—which seems to destroy them instantly. With thanks,

I am faithfully,

OSCAR MARESCAUX.

For fuller information consult Bulletin for May—July, 1898 which contains a re-print of a Bulletin of the U. S. Department of Agriculture,—"The principal diseases of Citrus fruits in Florida" by W. T. Swingle and H. J. Webber; also a publication by the Department of Agriculture, Victoria,—"Fungus diseases of Citrus Trees in Australia" by D. MacAlpine, Government Vegetable Pathologist.

VARIETIES OF COCOA.

Cocoa buyers state that a low price is frequently given because the beans are not all from the same variety of tree, that the good and inferior kinds are mixed, when naturally the inferior rules the price.

On many estates the pods are of all kinds, and it is impossible to say to what variety any particular tree belongs.

There are three chief varieties of Cocoa grown in the West Indies, viz., the Calabash, Criollo, and Forastero.

The calabash pod of typical form is small and round with a smooth skin; the beans are flat, bitter, and of a dark purple colour inside.

The Criollo pod is thin-skinned, and has a "bottle-neck" near the stalk; the beans are rounded, sweet, and white inside.

The Forastero has a thick skin, deeply furrowed; the beans are somewhat rounded, slightly bitter and pinkish within.

The Criollo cured Cocoa gets the highest price, but the tree is the most delicate of all, and liable to disease. It can only be grown on the very best soils.

The Calabash Cocoa takes twice the time and attention to ferment it as the Criollo, and fetches a very low price. The tree is, however, very hardy, and will thrive on poor soil where other kinds would not grow.

The Forastero is intermediate in character between the other two. The quality of the cured cocoa is good but not as fine as Criollo. The tree,, however, is not subject to disease, and bears large crops. This is the variety recommended for planting in Jamaica, and is the one distributed from Hope Gardens.

It is of great importance to planters to have as nearly as possible

only one kind on his estate. For instance, if an estate has some trees of the Calabash variety and some Forastero, the beans must be separately cured, or the fermentation will be too long for some and too short for others, resulting in a badly cured sample.

In planting out an estate for the first time, the choice should be made of one variety and nothing else should be grown. Many estates get a low price for the cocoa, simply because the trees are not even in character. The colour of pod does not matter.

As regards situation for growing Cocoa, it should not be planted on dry ridges, but in moist sheltered valleys, and this is essential in districts where the rainfall is small and uncertain.

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Report, Botanic and Afforestation Dept., 1900. [Actg. Supt.]

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Michigan. 187 (Report of South Haven Sub-Station, 1900]
(188 Experiments with Sugar Beets)
Ohio. 122 (Onion Smut. Preliminary Experiments.) 123 (I. Grape Rots in Ohio. II. Experiments in the prevention of Grape Rot.) 124 (The maintenance of Fertility. Field Experiments with Fertilizers on Corn, Oats and Wheat in 1899 and 1900.) 125 (The Maintenance of Fertility. Field Experiments with Fertilizers on Potatoes 1894 to 1900.)

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Index ditto ditto Vol. I, 1890-1900 } [Director.]
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Culture of Uredineae in 1899
Formalin and Hot Water as preventives of Loose Smut of Wheat } By J. C. Arthur.
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The Asparagus Rust } [Author.]
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Pine Apple Fertilizers. By P. H. Rolfs. [Author.]
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Planter's Monthly, Hawaii, June. [Editor.]

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Catalogue of the African Plants collected by Dr. Friedrich Welwitsch in 1853-61. Vol. II., Part II. Cryptogamia. London, 1901, 4to. [Presented by the Trustees of the British Museum.]
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Nicholson (George). The Century Supplement to the Dictionary of Gardening. Edited by G. Nicholson, assisted by others. G. to Z. London. 1901. 4to. [Purchased.]

SEEDS.

From C. J. Winter, Esq., H. M. Legation, Guatemala.
Cocoa.

From Botanic Gardens, Sydney.

Banksia collina; B. latifolia, var. minor; B. marginata; B. paludosa; Conospermum ericifolium; C. taxifolium; Grevillea acanthifolia; G. asplenifolia; G. Banksii; G. buxifolia; G. Caleyi; G. laurifolia; G. linearis; G. oleoides; G. punicea; G. robusta; G. sericea; Hakea dactyloides; H. gibbosa; H. propinqua; Isopogon anemonefolius; I. anethifolius;

Lomatia silaifolia; Persoonia Chamaepeuce; P. lanceolata; P. lineris; P. pinifolia; Petrophila pedunculata; P. pulchella; P. sessilis; Stenocarpus salignus; S. sinuatus; Xanthorrhoea arborea; X. hastilis.

From Victoria-Kamerun, West Africa.

Raphia vinifera.

From R. Botanic Garden, Sibpur near Calcutta.

Cicer arietjinum (Gram & Horse Gram Seed); Phaseolus aconitifolius; P. aureus; P. Max; P. Mungo; P. pilosus; P. Roxburghii.

From Botanic Gardens, Hong Kong.

Quercus Blakei; Q. Edithæ.

PLANTS.

From Miss Roper, St. Ann.

Lycopodium taxifolium.

HERBARIUM.

From Dr. M. Grabham, Kingston.

Specimens of Tournefortia astrotricha.

From Miss Steer, Claremont.

Flower of Vanda teres.

[Issued 11th, July 1901.]

JAMAICA.

BULLETIN

OF THE

BOTANICAL DEPARTMENT.

New Series.] AUGUST, 1901. Vol. VIII. Part 8.

FUNGOID DISEASES OF COCOA.

Cocoa in Jamaica has not been troubled much so far with disease, but there is no doubt that injurious fungi exist to some small extent. It will be advisable that planters be on the watch, and adopt the remedies suggested by Mr. Howard in the following report. If not the pest will continue to extend on heaps of the decaying shells until it is strong enough, and the opportunity of favourable weather occurs, when it may spread with great rapidity, and do much damage.

Commissioner of Agriculture for W. Indies to Director of Public Gardens and Plantations, Jamaica.

Imperial Department of Agriculture
for the West Indies, Barbados.
8th June, 1901.

Sir,

I beg to forward, herewith, a copy of a report on the fungoid diseases of Cacao in Grenada prepared by Mr. Albert Howard, Mycologist to the Imperial Department of Agriculture for the West Indies.

2. You will no doubt be glad of the opportunity of reading this report which has an important bearing on the success of the Cacao industry in these Colonies.

3. The "brown-rot" fungus of the Cacao pod has been determined at Kew, from specimens forwarded by this department, as *Diplodia Cacaoicola* (P. Henn.) This parasite has so far been found attacking Cacao pods in Dominica, St. Lucia, St. Vincent as well as in Grenada. The fungi concerned in the "canker" disease of the stem, which is known in Dominica as the "flowering" disease, have been determined at Kew as *Nectria Theobromae*, Massee (n. sp.) and *Calonectria flavida*, Massee (n. sp.). It is very probable that the "Root" fungus is a species of *Polyporus*, somewhat similar to that attacking the roots of forest trees in Europe.

I have the honour to be,
Sir,
Your most obedient Servant,
D. MORRIS,
Commissioner of Agriculture for the West Indies.

Report on the Fungoid Diseases of Cacao in Grenada by the Mycologist.

In accordance with instructions received from the Imperial Commissioner of Agriculture for the West Indies, I left Barbados for Grenada on Thursday, February 13th. I arrived in that island on Friday, February, 14th, and left on Friday, March 15th. I was therefore engaged on this service for 31 days in all During this time, I visited some nineteen estates in various parts of the island, as well as several small holdings in the Grand Roy valley and in the neighbourhood of Greenville . .

I was able to examine the trees in all the chief Cacao districts in the island and to gain a fairly accurate idea of the economic importance of the fungoid diseases of that crop The remainder of my time was spent at the Botanic Station where I improvised a small laboratory for the microscopic work and carried out infection experiments on healthy cacao trees and pods.

Three distinct fungi were found to be attacking Cacao, and, in the following, it is proposed to give a very brief and simple account of these diseases and to suggest the remedial measures which the nature of the case demands. I propose to speak of these Fungi as (*a*) the "brown rot" fungus of the pod; (*b*) the "canker" fungus of the stem; and (*c*) the "root fungus" respectively."

In order to make what follows more clearly understood, it will not be out of place to point out that the Fungi are a large group of the lower plants which are characterised by the entire absence of green colouring matter and which includes (1) forms which live only on living plants and animals (parasites); (2) those which live only on dead vegetable or animal matter (saprophytes); and (3) forms which are intermediate between these two classes and which live either on dead matter or on living plants and animals according to circumstances. To this latter class belong the fungi attacking the Cacao in in Grenada which are dealt with in this report. The vast majority of the fungi are so minute that recourse has to be had to the microscope for their study and this no doubt accounts for some of the misconceptions met with as to the nature of this group. In place of the roots, stem and leaves of a flowering plant, we find in a fungus a network of very minute branched tubes which penetrate the tissues of the material (whether dead or living matter) on which it lives. We can regard these branched tubes as the "roots" of the fungus,* which in the case of fungi which attack plants are found to extend through the tissues of the part attacked, to live on the materials found therein and to cause so great a disturbance in the normal processes going on in the attacked plant (the host) that the victim is either killed outright or a distorted unproductive plant results, which is quite useless from the point of view of the agriculturist. As a general rule reproduction in fungi takes place by means of minute bodies called spores which correspond roughly to the seeds of the higher plants and which are so small that they easily float in the air. In the absence of direct sunlight and

* This portion constitutes what is known as the *mycelium* or that part of the fungus which is engaged in absorbing nourishment from the dead or living matter on which it lives. The minute branched tubes making up this *mycelium* are

in the presence of moisture, fungus spores, as a rule, germinate rapidly and send out a minute tube or "root" which under suitable conditions penetrates the tissues of the host plant and sets up disease.

"Brown-Rot" Disease of the Cacao Pod.

General Characters.—In every district in Grenada Cacao pods may be found which show distinct brown patches which gradually extend over the pod. This must not be confused with the rusty or "mahogany" pods which result from "Thrips" where the whole of the pod takes on a rusty colour, but where the rind is not diseased. The brown patches in question generally commence either at the insertion of the stalk or at the free end of the pod, but they may occur at other points, especially when the rind has been injured or where the pod comes in contact with a branch. These diseased pods are particularly numerous near the "breaking grounds" where the beans are extracted by the pickers. If one of these attacked pods is carefully examined, it will be found that the brown area is rotten and that the discolouration extends to and spreads round the shell of the pod to a much greater distance than would be supposed from a surface examination. Decay soon spreads to the beans which are speedily covered with a greyish mould-like substance which quickly destroys them. The beans of nearly ripe pods instead of being covered with the usual moist and sweet mucilage are dry and the contents of the pod have a sour smell.

Microscopic Characters.—Microscopic examination of the tissues of the brown patches shews that they are filled with the "roots" of a fungus which exhibits all the characters of rapid growth. These roots extend round the shell, penetrate it and reach the mucilage surrounding the seeds where they grow with enormous rapidity and luxuriance, and, after penetrating the skin of the seeds, attack the beans themselves which become discoloured and ultimately rotten. When the brown patches have extended to two or three square inches on the surface of the pod, small circular mounds can be seen near the centre of the discoloured area from which a greyish-white powdery dust is expelled which turns black in a short time. This dust is composed of fungus spores which are at first colourless but which rapidly darken on exposure to light. They are formed in spherical bags just under the skin of the pod from which they are squeezed out through a small opening when ripe. It was therefore highly probable that the disease in question is caused by this fungus and to place the matter beyond any doubt whatsoever the following infection experiments were performed:—

Infection Experiments.—The fungus in question was identical with that found on the specimens of diseased cacao branches and pods sent from Grenada last year. It is referred to in the supplement to Mr. Lefroy's report (G.3745 of December 24th, 1900) which was published in the Grenada Official Gazette as probably doing some damage to the cacao in certain localities in that island. Fortunately I had been able to follow out the development of this fungus from a single spore and to prepare many pure* cultivations with which the most trustworthy

* A *pure cultivation* of a fungus is a growth of the *mycelium* of that fungus, unaccompanied by that of other forms, in a suitably prepared food substance. It therefore denotes an artificial growth of a *single* fungus unmixed with other forms.

infections experiments could be performed. I took the precaution to take a number of these pure cultivations to Grenada. The infection experiments were carried out on healthy cacao pods at the Botanic Station and were as follows:—

1. On February 24th I placed some of the "roots" of the artificially grown fungus into a small cavity made in the rind of a nearly ripe cacao pod, taking the usual precautions to sterilise* the needles used and to destroy any chance spores that might be on the outside of the pod where the incision was made. Afterwards the wound was bound up with a water-tight bandage. Another similar pod near was treated in a similar manner, except that no fungus was placed in the cavity. This served as a control or check experiment. The result was most marked. On March 1st, *i.e.* 5 days afterwards, about a quarter of the surface of the pod into which the fungus had been introduced had turned brown, and, on March 4th, the whole pod and its contents were rotten and there was a copious development of the characteristic spore sacs and spores near the point of infection. These spores agreed exactly with that from which the artificial cultures had been made. The control pod showed no infection.

2. On March 11th the above experiment was repeated, and in this case, two nearly ripe pods were infected with fungus from a pure cultivation, while a third was used as a check experiment. On the 14th March—three days afterwards—the two pods into which the fungus had been introduced shewed very distinct infection while the check experiment gave negative results.

3. On March 4th infection experiments were made on Cacao pods which were green and only about half grown in order to determine whether the spread of the fungus is as rapid here as in nearly ripe pods. Proceeding as above, it was found that infection with spores was apparent in a week and that infection with artificially grown fungus or with the diseased tissue from another affected pod was much more rapid in the same time. The control pod showed no infection. On the whole there did not appear very much difference in the rate at which the disease spreads in ripe and unripe pods. In both it is extremely rapid.

4. Next an experiment was made in order to find out if the spores of the fungus were able to infect a cacao pod where the rind had not been wounded. On March 4th, a drop of water containing many of these spores was placed on a ripe cacao pod and the drop was covered with a small glass cell which was sealed into the pod by means of budding wax. The cell was then covered with a bandage to shield the spores from direct sunlight. On March 11th it was found that the spores had germinated, but no penetration of the rind by the fungus "roots" was detected. Unfortunately, it was not possible to begin a further series of experiments to settle this point definitely. Although this single experiment was unsuccessful, nevertheless it will be seen in the following that there is every reason to believe that in the majority

* In performing infection experiments it is necessary to be quite sure that no chance fungus spores are introduced by means of the instruments used. It is usual to ensure this by passing the needles and knives through a flame and so destroy any accidental spores that may be on them. This operation is known as sterilisation.

of cases natural infection actually does take place by germinating spores without any previous wounding of the rind. I have no doubt that, had time permitted, further experiments would have conclusively proved that this is the case.

Natural Infection.—We should expect that since moisture is essential for the germination of spores that infection of cacao pods would take place naturally at those points where water is likely to remain for the longest time. These points are the groove round the insertion of the pod stalk, the points where a pod comes in contact with a branch, and the free end of the pod itself where after rain a drop of water remains for some time after the rest of the surface is quite dry. Observation shows that the disease generally starts from these points. Since infection takes place by means of spores, we should also expect the disease to be most prevalent where these spores are present in greatest numbers. Undoubtedly this is near the "breaking-grounds" since here it was noted that the fungus under discussion lives on the old husks of the cacao pods on which it forms myriads of spores. These can be seen with the naked eye as a black dust covering the blackened pods. It is actually found that the disease occurs to a greater extent here than elsewhere. The same fungus is also to be found on the dead prunings which are sometimes left under the cacao trees and also on diseased sugar cane in places where this cultivation is carried on among the young cacao

General Conclusions.—There is no doubt that the "brown rot" of the cacao pods is due to a fungus, and not as is supposed in some parts of Grenada to "Thrips," sunburn or to over-ripeness Infection takes place by means of spores which may set up the disease at a wounded surface or very probably at those points where water is apt to remain longest without any bruising of the rind. The fungus is widely distributed in the island occurring on the old husks of the cacao pod, on old prunings, and even on diseased sugar cane.

DAMAGE DONE TO CACAO TREES BY THE "BROWN ROT" FUNGUS.

During the progress of the investigation it appeared highly probable that some damage was being done by this fungus to the cacao trees themselves and especially to the young cultivation. It was found that young cacao trees from two to six years old and even more, were dying off from some reason that was not at once apparent. "Thrips" were usually alleged to be the cause, but I saw no reason to accept this view as the number of these insects present was not sufficient to cause any damage whatsoever On examination of the trees in question I found they were being attacked by a fungus which was apparently identical with that causing the brown-rot of the pods. Unfortunately there is no striking external evidence of the presence of this fungus in the diseased trees. The branches die off and decay spreads to the stem after which death rapidly takes place. The dead wood turns brown and dries up while there is a gradual transition between the dead and still living portions of the branch or tree. In these regions the brownish discolouration is seen to be due to a fungus which can be traced in the wood to some distance in front of the discoloured areas. Under the cracks of the recently killed bark the spore sacs of the fungus are formed and the dark masses of ejected spores can sometimes be made

out by careful examination with a lens or magnifying glass. It now became necessary to prove whether or not the "brown-rot" fungus is really the cause of the damage done to the cacao trees in question, and in order to do this, infection experiments were made on healthy cacao trees at the Botanic Station.

Infection Experiments.—Experiments were carried out on young cacao plants growing in bamboo pots, on trees eighteen months old and on adult trees.

1. On February 24th, two branches about two inches in diameter of a healthy tree were selected for the experiment. The outer dry bark was carefully peeled off about one square inch of the surface which was then sterilised to kill any fungus spores upon it. A small chamber was then made with a sterile knife at these points by raising the bark and cutting out the tissues underneath down to the wood. Into one of these a portion of a pure cultivation of the brown-rot fungus of the pod was introduced and the whole covered with a water tight bandage. The second branch was treated in exactly the same way except that no fungus was introduced. This served as a check experiment. The result was surprising. On March 4th—eight days afterwards—it was found (in the case of the branch where fungus had been introduced) that the bark had been killed to a distance of eight inches above and below the point of infection and the branch was nearly "ringed." The attacked bark was found to be filled with the "roots" of a fungus which had also made their way into the young wood to the depth of a quarter of an inch under the point of infection and to about a foot above and below the chamber where the fungus was introduced. Spore sacs containing spores were formed under the bark and these agreed in all their characters with those found on the brown pods. The control or check experiment showed no infection.

2. Eight healthy cacao plants, about eight months old, growing in bamboo pots were next experimented upon. On March 4th, Nos. 1 and 2 were inoculated with the spores of the fungus taken from a pod attacked by "brown-rot" by introducing them into a slit made in the bark of the stem. Nos. 3 and 4 were similarly inoculated with small portions of the diseased rind of a cacao pod attacked by "brown-rot" which contained the active "roots" of the fungus. Nos. 5 and 6 were inoculated with "brown rot" fungus growing artificially in a pure cultivation, and Nos. 7 and 8 were control plants. After inoculation, the plants were placed in the shade and watered daily. On March 12th the disease had established itself to a greater or less extent in all the plants from one to six while Nos. 1 and 6 themselves had been killed by the disease. The control plants showed no infection.

3. Four extremely vigorous young cacao trees about eighteen months old which had been planted out at the usual time were selected for this experiment. On March 4th, three were infected under the bark with fungus spores, diseased rind from a cacao pod attacked by "brown rot" and artificially grown fungus respectively. The fourth tree was treated exactly like the rest except that no fungus or spores were introduced and served as a check experiment. On March 12th the disease had established itself in the first three trees and especially in No. 2 which had been inoculated with a small portion of the tissue of a diseased pod. Here the disease could be traced in the young tree to about eight

inches above and below the point of infection and the characteristic spore sacs and spores had developed under the bark near the point of infection.

4. An experiment was now performed in order to determine whether infection could be obtained by spores without first of all piercing the bark. A drop of water containing the spores of the fungus under discussion was placed on a branch of an adult cacao tree and covered with a small glass cell which was sealed to the bark with budding wax and shielded from the sun. After seven days it was found that although the spores had germinated no penetration of the bark could be detected. Time did not permit of further experiments on this point and the evidence as far as it goes points to the probability that infection of the cacao tree takes place at wounded surfaces in the bark. Obviously only a very small wound is necessary such for example as a minute crack or the hole made by a "boring" insect.

These infection experiments leave no doubt that the "brown-rot" fungus of the pod also attacks the cacao tree and that the young cultivation referred to above had been badly attacked by this pest. Fortunately, however, these experiments indicate that a wound is generally necessary for infection to take place, a point of which great advantage can be taken in combating the disease.

Remedial Measures—In suggesting remedies for fungoid diseases like the one under discussion it is obvious that when once the fungus is well established in a tree or pod nothing can be done to save the portions attacked, and that attention must be directed to prevent further infection by assisting the trees to ward off attack and by destroying as far as possible everything in the cacao plantation which harbours the spores of the fungus. In this way, the pest can be kept well in hand and future trouble avoided. The following measures are suggested in dealing with this pest:—

1. All husks or shells of the cacao pod should be buried as soon as possible after the beans have been extracted. This practice is carried out on many of the best estates in Grenada at the present time with very good results and it is hoped that it will soon become a part of the regular estate routine all over the island When the pods are allowed to remain on the ground they are really nurseries for the "brown-rot" fungus and speedily becomes covered with spores, thus serving as centres of infection of the disease. If they are buried fresh this fungus does not develop, decay sets in, and the resulting humus improves the texture of the soil. Lime should be mixed with the fairly fresh pods so as to hasten decay and prevent local souring of the soil which may easily damage the neighbouring trees, esp cially if the buried heaps are large. It would be well if the "breaking-grounds" were moved from time to time so as to give as many trees as possible the benefits of this manuring. Old black pods which have been lying on the ground for some time and which are covered with spores should be collected and burnt.

2. All pods in which brown-rot is detected should be picked at once so as to prevent the disease spreading to the tree through the pod stalk. If this is done early ,the beans can be saved. The husks of these pods should be buried away from the cacao trees or burnt. On no account should the beans from these pods be used for growing seedlings.

3. All dead cacao trees, old prunings and dead branches, should not be allowed to remain under the cacao trees, but should be periodically collected and burnt as is done on the best Grenada estates. Dead trees should be cut down level with the ground and old stumps should never be left as these are often covered with fungus spores. The ashes should be spread under the cacao trees as they are rich in potash and serve as a useful manure.

4. All wounds made in pruning should be tarred over when made so as to prevent the infection of the tree by means of fungus spores. As far as practicable, the cuts should slope in such a way that rain water runs off easily and the surface dries quickly. Tarring will only be satisfactory if the pruning is done at a time when the sap is not rising as in the dry season and if the least possible quantity of tar is used. If too much tar is applied, the excess runs down the stem producing an unsightly smear which in addition is harmful to the tree. There are several other obvious advantages to the cacao tree in tarring the cuts besides the prevention of fungoid diseases. Local wood-rot is prevented and the tree covers the wound with the least expenditure of material by growing new bark all round and also boring insects, like the cacao beetle, are prevented from laying their eggs on the freshly cut surfaces. Neglect of this precaution in the past is obvious in many of the small holdings in Grenada where so great has been the damage by insects and fungi that the trees have never been able to cover their wounds by fresh growth and their efforts in this direction have so told upon their vitality that their bearing powers have been very considerably reduced. On the other hand on several of the larger estates when "tarring" has been adopted for some time and where very extensive pruning has been done, the trees are bearing well and appear remarkably healthy.

5. In cases where trees are being killed by this fungus they may be often rejuvenated by replacing them by a sucker. I noticed vigorous suckers growing from the base of several trees about five or six years old attacked by this disease and it seems reasonable to suggest that a root sucker should always be allowed to grow from the base of all sickly looking trees and from those which have been badly attacked by beetle grubs. When the suckers are a few feet high, the parent tree could be removed and the sucker allowed to take its place. In this way, a diseased tree could be replaced much more quickly and satisfactorily than if a fresh tree were planted.

6. In removing the grubs of the cacao beetle, care should be taken to injure the bark as little as possible. If the wounds made are considerable they should be tarred.

I feel sure that if these simple measures are made a part of the routine of the Grenada cacao estates, not only will this fungus be kept well in hand, but the production of cacao will be materially increased. Although it would be best if the planters were to adopt these measures universally, nevertheless, from the configuration of the island and the nature of the cacao crop and of this disease, each planter is to a large extent independent of his neighbour. It not infrequently happens that when a course of action produces obviously good results there is no lack of imitators.

THE "CANKER" FUNGUS OF THE CACAO STEM.

General Characters.—Soon after my arrival in Grenada I discovered a bark disease of the cacao tree which was subsequently noted in all the districts of the island I visited. In all probability it is responsible for most of the trees which die off somewhat suddenly and from no apparent cause. The first well-defined symptom of this stem disease is a reddish gummy liquid which oozes out of the bark of the stem and which when dry gives a rusty appearance to the bark. This may be termed the "bleeding" stage and even now the disease is well established. On cutting into the tree at these points it is found that the bark is deep claret red in colour and moist and soapy to the feel. The discolouration extends to the young wood and on removing all the diseased bark it can be seen that the darkening of the wood extends for some distance under the still healthy bark and that the diseased patch increases in size from beneath outwards rather than from the surface. The disease may start from any point on the stem and in many cases there are two or three points of attack on the same tree. The spread of the diseased area varies a good deal. Sometimes when the patch is only three or four inches in diameter it rapidly extends on either side and "rings" the tree completely. When this is complete the tree dies off suddenly often bearing a full complement of leaves and pods in all stages of growth. In other cases the diseased area extends slowly in all directions and "ringing" does not take place for some time. In such cases the death of the tree is much more gradual than before, the branches immediately above the diseased patch dying off first of all followed by the rest as the diseased patch extends. In some cases, and these are apparently rare, the tree recovers from an attack by cutting off the diseased area by the growth of fresh bark from below. In these cases the disease had not reached the wood. In general diseased trees rarely occurred singly, but several were noted close together indicating that the disease had spread from one tree to several of its neighbours.

Nature of the disease.—Microscopic examination of the discoloured bark shewed that the tissues were penetrated in all directions by the "roots" of a fungus and there were other evidences of fungoid attack in the still healthy tissues surrounding the diseased bark.

In the cracks of the discoloured bark several different kinds of spore were noticed which are probably connected with one or at the most two fungi, but the time at my disposal did not permit even of an attempt to work out the life history of these forms. Some of these spores are found in small red or yellowish lemon-shaped flask-like bodies about the size of a pin's head which appear in colonies on the diseased bark in the later phases of the disease when the tree is either dead or nearly so. The other spores occur on whitish cushions in the cracks of the bark of the bleeding patches at an earlier stage.

Infection experiments were performed at the Botanic Station on healthy cacao trees by introducing portions of the diseased bark from bleeding patches into healthy trees and binding up the wounds with water-tight bandages to prevent drying up. In all cases the "roots" of the fungus in the diseased bark made their way into the surrounding healthy bark for about half an inch all round, thus indicating that the fungus was parasitic. Unfortunately, however, the length of my

stay did not permit of further infection experiments being made with the various spores referred to while the evidence from these experiments as far as they go points strongly to the parasitic nature of the fungus found in the diseased bark, nevertheless, the point has not been proved so conclusively and so satisfactorily as in the case of the "brown rot" fungus of the cacao pod.

There is every probability that this disease is identical with the "canker" disease of the cacao tree in Ceylon and Trinidad which is caused by a fungus of the genus *Nectria*. There is little doubt that it is the cause of death of a good many cacao trees in Grenada which are popularly supposed to die on account of their tap roots having struck "tiff" or a flat stone. I was unable to find anyone who had verified these alleged causes by actual excavation and, in the case where a tree—attacked by the "canker" disease was dug up for my benefit, nothing of the kind was found and the root system was quite healthy.

Several trees suffering from this disease were found to be attacked by white ants. On careful examination, however, it was found that in each case the ants were followers of the fungus disease and did not attack the healthy wood. A similar state of things has been reported from Ceylon.

Remedial Measures.—The group of fungi to which this form in all probability belongs are wound-parasites and gain accsss to their hosts by means of spores which germinate on wounded surfaces. Fortunately, the suitable remedial measures are extremely simple and easy to carry out.

1. All wounds made in pruning and in removing beetle grubs should be tarred as mentioned above.

2. All dead trees killed by the "canker" disease should be cut down *at the ground* and burnt along with all the dead wood found in the cacao plantations.

3. The diseased bark of the "bleeding" patches should be cut out as soon as noticed Since the roots of the fungus are often found in the apparently healthy bark surrounding the diseased tissue it is necessary to cut out the claret coloured bark and about an inch of the surrounding apparently healthy bark as well When the disease has reached the young wood care should be taken to cut out any discoloured wood that may be noted. The wounds should be tarred over, and the diseased bark carefully collected in a sack or tin and burnt. The cutlasses or knives used in this work should not be used for pruning other cacao trees uutil they have been thoroughly washed and cleaned. In order to enlist the assistance of the estate workmen in this treatment, a small reward might be given for every tree discovered to be suffering from this disease.

4. In cases when the disease is established to such an extent that cutting out the diseased bark would not be likely to save the tree, it should be cut down at some distance below the diseased bark and replaced if possible by a new sucker. When, however, the disease is nearly on a level with the ground this is impossible and the best way to remove the tree at once and replace it by a fresh one. All trees cut down in this way should be burnt immediately.

The above remedies, if adopted, will I consider keep this disease

well in hand. As was only to be expected the disease is doing most damage among the older trees in neglected fields aud in the small holdings, where little if any care seems to be taken of the trees The disease has probably existed in Grenada for many years and there is no evidence to show whether it has increased or not during recent years. At the present time, it is of sufficient importance for the adoption of the remedial measures indicated, which will not only keep this disease in check locally, but, by preventing infection, will largely render any one planter independent of the attitude adopted by his neighbour.

"Root" Disease.

General Character.—In three instances cacao trees were met with which had dried off in small patches from no apparent cause. They had been growing in good well drained soil and were surrounded by healthy vigorous trees in good bearing. No indications of disease were found in the stems or branches of these trees, but on examining the root system, it was found that the roots were decayed and filled with fungus, especially between the wood and the bark where the matted "roots" of the fungus can be seen with the naked eye as a white felt-like substance surrounding the wood. The characters of these "roots" showed them to belong to the highest group of the fungi which includes several forms which cause "root diseases" very much like the one in question. A similar if not identical fungus in all probability causes a root disease of the nutmeg in Grenada and also attacks many of the cultivated trees in the West Indies. Thus Mr. C. A. Barber in his report on the failure of the Dominica cacao crop in 1892-93 (Supplement to the Leeward Islands Gazette April 27th 1893) describes a root disease of the cacao in that Island which also attacked mangoes, oranges, coffee and breadfruit and which seems to be identical with the one under discussion. He also noted a similar disease in Jamaica, locally called "salt-petre," in the cacao and coffee cultivation. Last year cacao trees affected with this disease were forwarded from Dominica to the Imperial Department of Agriculture for examination It is highly probable that the root disease of the Grenada cacao is caused by the fungus found in the diseased roots and that it spreads from tree to tree underground by means of a diseased root of an attacked tree coming in contact with a living root of a neighbouring tree.

Remedial Measures.—The only practical remedy in diseases of this nature is to isolate the diseased tree from the rest of the plantation by means of a trench three or four feet deep dug midway between the affected tree and its neighbours and thus prevent the spread of the disease to the rest of the plantation The healthy trees surrounding the trench should be kept under observation for some time in order to determine whether the isolatiou has been done in time. The roots of the diseased trees should be dug up and burnt and the soil limed before planting a fresh tree. This treatment has already been successfully adopted by one of the leading planters in Grenada in the case of the nutmeg root disease and there is no reason to suppose that it would not be equally successful in the case of cacao.

Summary of Conclusions.

In reviewing the general situation in Grenada, the conclusion I have arrived at is that most of the damage alleged to be due to "thrips" is

really due to the fungoid diseases dealt with in this report, and while these diseases need not cause any great alarm at the present time, it should be clearly pointed out that the simple measures here advocated should be adopted throughout the island so as to keep these pests well in hand and prevent the possibility of a future epidemic which may easily cause wide-spread damage to a now flourishing industry. These measures may be shortly summed up as follows:—

1. The husks of the cacao pods should be suitably buried with lime under the trees as soon as possible after the beans have been extracted. Diseased husks should either be buried away from the cacao or else burnt.
2. All old prunings and dead wood in the plantations should be collected and burnt as often as possible and the ashes spread under the trees.
3. Diseased trees should be replaced by suckers whenever practicable. If this is impossible the tree should be cut off level with the ground and burnt.
4. In cases of the "canker" disease, the diseased bark should be properly cut and the wound tarred and the diseased bark burnt.
5. In cases of "root" disease, the affected trees should be isolated from the rest of the plantation by a suitable trench. The diseased roots should be dug up and burnt and the land limed before a fresh tree is planted.
6. In removing the grubs of the cacao beetle, the wounds should be tarred.
7. Seeds from diseased pods should never be used for raising seedlings.

A. HOWARD, Mycologist.

NOTES ON SOME RECENT CONTRIBUTIONS.

Mons. Chas. Patin, Consul General for Belgium at Medellin, Colombia, has on several occasions very kindly contributed seeds or plants both useful and ornamental, to the collections in the Public Gardens. His latest donation includes seeds of two species of Theobroma. Both are hardy, growing in any kind of soil, and it is thought that they may prove useful for hybridising purposes, or as stocks for grafting choice and delicate varieties of *T. Cacao* upon.

The pod and seeds of each species, and a single leaf of No. 1, are all the material that have been seen by us, so that the following provisional and imperfect descriptions have been prepared mainly from information supplied by M. Patin.

Theobroma sp. No 1.—A tree, leaves simple, oblong, slightly obovate, oblique and semi-cordate at the base, terminating abruptly in a short, blunt point, 6½″ long, 2½″ wide at the broadest part, dull green above, hoary tomentose beneath, veins conspicuous, reticulate, prominent on the lower side: petiole ¾″ long, rimose, and, with the mid-rib and the six pairs of principal veins, coated with ferruginous scales; flowers orange-yellow in colour; pod woody and thick, 7″ — 8″ long, 12″ in circumference, 5-ribbed, with warty excrescences, covered with brown felt-like tomentum. Each pod contains about 25 large seeds enve-

loped in mucilaginous pulp. The seeds of this species are not bitter to the taste.

Theobroma sp. No. 2.—A small, slender tree, with branches clustered at the top of the stem, and leaves at the end of the branches. The leaves are large, digitate, each leaflet being about the size of the leaf of *T. Cacao.* The pods which are produced in abundance along the main stem, are 4″ long, about 5″ in circumference at the middle gradually narrowing to a point at the apex, very prominently 10-ribbed with lateral transverse ribs in the deep furrows, orange-yellow in colour, about 12-seeded, the seeds embedded in mucilaginous pulp. The seeds of this species are very bitter.

AUSTRALIAN BRAZILETTO.

PELTOPHORUM FERRUGINEUM, BENTH

This handsome tree has lately been a mass of bloom in the Nursery at Hope Gardens. It is a native of the islands in the Malay Archipelago from Timor to the Philippines, and of North Australia.

It has beautiful dark-green, fern-like foliage, resembling somewhat our Wild Tamarind (*Pithecolobium filicifolium*), and large, branched, terminal panicles of fragrant flowers, the petals being crisped, and of a very showy yellow colour.

The tree has flowered regularly for a few years, and although pods are produced, good seeds have not yet been secured; we hope to be more fortunate this year, as such a fine, handsome tree should be propagated and widely distributed. In addition to being a beautiful flowering tree, it is also a very desirable shade tree. It is always in leaf, and its graceful foliage affords a grateful shade, not too dense, but just sufficient to be cool and refreshing.

The colour of the flowers does not agree very well with the plate in Trimen's Flora of Ceylon, inasmuch as the petals are a pure yellow with a touch of purplish-brown quite at the base.

JAMAICA BRAZILETTO.

P. LINNÆI, BENTH.

This is also a handsome tree growing in dry rocky soil. The flowers are small compared with its Australian sister. The timber is sometimes large, the tree growing 50 or 60 ft. high, and 3 ft. in diameter, but at other places giving planks not wider than 8 or 10 inches. It is an excellent cabinet wood, elastic, tough and durable, of a beautiful orange colour, and takes a fine polish. It is used also for spokes of wheels, and for carriage building generally.

AN INCH OF RAIN.

What does an inch of rain mean? Few persons have a definite idea. An acre, if calculated out, will prove to be 6,272,640 square inches. An inch deep of water on this acre will be as many cubic inches of water, which at 231 to the gallon, is equal to 27,154 gallons. This immense quantity of water will weigh 228,190lbs., or 101 tons. One hundredth of an inch (.01) alone is equal to over 1 ton of water to the acre. One inch of rain is equal to 4½ gallons a square yard, or 101 tons per acre.

ADDITIONS AND CONTRIBUTIONS TO THE DEPARTMENT.

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T. sp. No. 2.
Pachira sp.

Reasoner Bros., Florida.

Rubus cuneifolius.
Waldo peach.

PLANTS.

Mr. Ed. D. Kinkead, Richmond Park.

Cuttings of Lagerstroemia indica (rose-coloured variety.)

[Issued 14th, August, 1901.]

JAMAICA.

BULLETIN

OF THE

BOTANICAL DEPARTMENT.

New Series.] SEPTEMBER, 1901. Vol. VIII Part 9.

HISTORICAL NOTES ON ECONOMIC PLANTS IN JAMAICA.

By the Editor & W. Harris, F. L. S.

Introductory I.

The following extracts from early authors may serve as a general introduction :—

In "a brief description of the island of Jamaica * *," which forms one chapter in "A Book of the Continuation of Forreign Passages * * * moreover an attempt on the island of Jamaica", published in London in 1657 (the earliest account of the island published after the English took possession of the island), the following account is given of the fruits, &c. : "and Dr. Heylin in his Description of the American Islands [Heylin, John, D.D. "Microcosmus"—Oxon, 1622] saith of *Jamaica* * * * well stocked with cattell, and no less plentifully stored with most sorts of fruits, which either industry or nature have supplied it with ; great store of cotton-wool, and such abundance of Jaccu (a Root whereof the savages once made their bread) that it was deemed the granary of the neighbouring islands. * * *

Severall sorts of Wood in this Country.

1. *Grandillio,* of a reddish black colour, and heavy as ebony used much is these parts for bedsteads.
2. *Cedar,* the best in all the Indies, usefull for all purposes, as Oake in England.
3. *Cawobena,* a tree of six fathoms about, a fine red, excellent good for beds, tables or buildings.
4. *Cittano,* of a yellow colour, a fathome about, excellent for dying, called in English, yellow Fustick.
5. *Brasil and Brasiletto,* excellent for dying, sold in these parts at one pound seventeen shillings and sixpence per hundred.
6. *Guaicum,* good for bedsteads, bowls and chairs, and Physicians uses, three foot over, sold at Carthagena for two shillings per pound.

The Country affords severall Fruits.

1. Pepper smelling like Cloves, the North side of the Island is full of it, wild, good for Chocolatto, sold here at sixpence per pound. The

Leaf distilled, makes excellent good water, much esteemed by the Spaniards at *Carthagena*.

2. *Pyne*, the best that ever was eat, in season almost all the year long, sold at sixpence per piece.

3. Nispero, esteemed the best fruit in the Indies by the Spaniards, in season in *July* and *August*.

4. Mamesappote, tastes like marmalet, in season part of June, July, and August.

5. Avocatas, a wholesome pleasant fruit; in season in August, sold for eightpence per piece.

6. Cocao, in great plenty, of which they make Chocolatto, sold ordinarily for three shillings per bushell.

7. Catrao, a very sweet luscious fruit, green of colour, and much like a mulberry in shape and bignesse.

8. Limes, Limons, Oranges, Guavers, Bonana's, Plantan's. Papaas, Melons of all sorts, and very good Cucumbers, Gourds, &c., and the largest Potatoes ever eye beheld.

9. Tobacco, which at Carthagena bears the best rate there.

10. Indico."

Venables, in a letter to "a person of Honour", quoted in the same work, says "That which we most want for the present, is bread and Bandry, there being not much Casava in the country, and of that the enemies steal a share * *."

Richard Blome in his "Description of the Island of Jamaica" (London, 1672), says:—

The Fruits.

There are great plenty of choice and excellent Fruits in this Island, as Oranges, Pome-granates, Cocar-Nuts, Limes, Guavars, Mammes, Alumee-Supotas [sic], Suppotillias, Avocatas, Cashues, Prickle-Aples, Plickle-Pears, Grapes, Sower-Sops, Custard-Aples, Dildowes, and many others whose names are not known, or too tedious to name, besides Plantains, Pines, &c.

Their Herbes and Roots.

Here likewise grows very well, all manner of Summer-Garden-Herbs and Roots common to us in England, as Radish, Lettis, Purseley, Cucumbers, Melons, Parsley, Pot-herbs, also Beanes, Pease, Cabbages, Colly-Flowers, &c.

Joseph Acosta, in his "Naturall and Morall Historie of the East and West Indies." (London, 1604), says:—

"In some parts of the Indies they use a kind of bread they call Cacavi, which is made of a certain root they call Yuca."

Again:—

"They have not found at the West Indies any kinde of spices, proper or peculiar to them, as pepper, cloves, cinamon, nutmegges, or ginger, although one of our company, who had travelled much, and in diverse partes, told us, that in the desarts of the Iland of Jamaique he had found trees where pepper grewe. But they are not yet assured thereof, neither is there anie trade of these spices at the Indies. The ginger was carried from the Indies to Hispaniola, and it hath multiplied so, as at this day they now not what to do with the great abun-

dancy they have. In the fleete the yeare 1587, they brought 22053 quintalls of ginger to Seville: but the naturall spice that God hath given to the Weast Indies is that we in Castill, Indian pepper, and at the Indies, Axi, as a generall word taken from the first land of the ilands, which they conquered. In the language * * of Mexico, Chili."

Again:—

"Of grapes, vignes. olives, mulberies, and kanes of Sugar."

In "Interesting Tracts relating to the island of Jamaica" (St. Jago dela Vega, 1800). The planters of Withywood [Vere] complain that they cannot sell their indigo at Port Royal, as they were undersold by the pirates encouraged by the Governor (Earl of Carlisle). 1680.

Again:—

In "Instructions to Sir Philip Howard, Governor [who never came]" "We do hereby authorize you to forbear, if you shall think fit, the taking advantage of any penalty or forfeiture against any of the present planters or inhabitants of the said island, for not *manuring* or planting of their lands according to their time heretofore limited and appointed them for the same, &c." 1685.

Again:—

Dec., 4 [1664]. "About this day appeared first the comet which was the forerunner of the blasting of the cocoa trees, and after which time they generally failed in Jamaica, Cuba and Hispaniola."

II.—The Pine Apple.

The Pine-apple is a native of tropical America, but it is scarcely possible to decide whether it is truly indigenous in Jamaica; other plants belonging to the same Natural Order (*Bromeliaceae*) are everywhere abundant. If not a true native, it was probably brought from the mainland by the Arawâks, and later by the Spaniards It appears on the Coat of Arms as if it were a natural product. Large patches of the "Cow-boy" Pine grow wild in the district of Vere in Clarendon. The plants attain a height of five feet, and grow in dense thickets, so that it is difficult to get at the fruit which are somewhat freely produced. The soil in the district seems to be admirably adapted for the growth of this plant.

Joseph Acosta in his "Naturall and Morall Historie of the East and West Indies" (London 1604) says (p. 762): "The first Spaniards named many things at the Indies with such Spanish names as they did most resemble as Pines, Concombres, and Prunes, although they be very different fruits to those which are so-called in Spaine. The Pines or Pine-apples, are of the same fashion and forme outwardly to those of Castille, but within they wholly differ, for that they have neither apples nor scales, but are all one flesh, which may be eaten when the skinne is off, it is a fruit that hath an excellent smell, and is very pleasant and delightful in taste, it is full of juyce and of a sweet and sharpe taste, they eate it being cut in morsells, and steeped a while in water and salt. Some say that this breedes choler, and that the use thereof is not very healthful. But I have not seene any experience thereof that might breed beliefe. They grow one by one like a cane or stalke which riseth amongst many leaves, like to the lillie, but somewhat bigger. The apple is on the toppe of every

cane, it grows in hot and moist groundes, and the best are those of the islands of Bartovente [Greater Antilles].

In 1622 Dr. Heylin states that they "were sold at sixpence per piece."

Hans Sloane, who visited Jamaica in 1689, says in his "Natural History of Jamaica": "This fruit is planted and used by way of dessert (having a very fine flavour and taste) all over the hot West Indies, and either raw, or when not yet ripe, candied, and is accounted the most delicious fruit these places, or the world affords, having the flavour of raspberries, strawberries, &c., but they seem to me not to be so extremely pleasant, but too sour, setting the teeth on edge very speedily." The fruit seems to have been poor, but new and better varieties were soon produced, for Patrick Browne in his "Civil and Natural History of Jamaica," published in 1756, gives the names of three varieties and says of the first that some "think it too rich and cloying." His statement is as follows :—

"*The Sugar Loaf Pine-Apple*—This plant is now common in Jamaica, and cultivated by most people in their gardens : it is propagated both by the crown and the sprouts or side branches. but these come to perfection earlier, though the other seems the most natural gem, as it always casts its roots in the fruit itself, while yet in a growing state : they thrive best in a rich mould and a warm situation, but seldom rise above three feet from the ground ; the stalk shoots from the centre of the leaves (which are generally disposed very thick about the root) and bears a large single fruit, or rather a heap of small succulent capsulæ, concreted into a common mass towards the top ; but the fibres of the main stem continue their course through the centre of this mass, and in most species, turn into a short foliated sprout, or young plant, at the top, casting a few tender radiculi on every side, into the pulp of the fruit.

"This has been always esteemed the richest and best fruit in America ; aud indeed its form, size and flavour contribute alike to give it the pre-eminence ; it is in general agreeable to the stomach : but the natural mellowness of its juice renders it more agreeable to the natives and old standards, than it possibly can be to new-comers, who generally think it too rich and cloying. The following sorts are thought to be only variations of this, but they are seldom so luscious, grow generally of a different shape, and are vastly more agreeable to heated stomachs. The juice fermented would make a good wine ; it is sometimes mixed with the rum liquor, when it ferments, and is thought to give it pleasant flavour ; it is served up with other fruit at most gentlemen's tables in America.

"*The Black Pine-Apple. The Queen Pine-Apple.*—These two last species are more common than the first, and planted in most gardens in this country, their fruit is generally large and roundish but grows seldom yellow, even in the surface, nor is the pulp of the fruit so rich though generally more agreeable to new-comers, and people of a warm habit."

In the "History of Jamaica" by Edward Long, published in 1774, the following varieties are mentioned :—

"The bog-walk pine, of a compressed form, and deep green coat, white flesh.

"The same with a yellow coat.

"The pyramidical or sugar-loaf, with yellowish flesh, and deep green coat.

"The same with a yellow coat.

"The smooth-leaved or king pine.

"The queen pine, with leaves smooth, or sometimes spiked.

"The smaller green or yellow pyramidal or Montserrat.

"The bog-walk pine is not so sweet or agreeable as the others; and next to the sugar loaf the Montserrat pine is reckoned most eligible; there is, however, a variety in their flavour, accommodated to different palates, some being more acid, or more rich and cloying than others.

"The fermented juice of the sweeter sorts has been made into a very pleasant wine, and is sometimes mixed in the cisterns that contain the liquor for rum, in order to communicate a more agreeable zest."

In "Hortus Jamaicensis," by John Lunan, published in 1814, the following varieties of Pine-apple are mentioned:—Queen, Sugar-loaf, King, Smooth Green, Black Antigua or Ripley, Grenada, Bog-walk, Smooth long narrow-leaved, Montserrat, Surinam, and he adds, "it is impossible to enumerate all, as new varieties may arise every day."

In the Annual Reports on the old Botanic Garden at Bath, in St. Thomas-in-the-East, from 1846 to 1861, inclusive, the Pine-apple is only mentioned, incidentally, as a fibre yielding plant. This may be accounted for by the fact that the district of Bath is a very wet one, and unsuited for the cultivation of this fruit.

In the year 1870 the following varieties of pine-apples were planted in Castleton Garden, viz, Enville. Prickly Cayenne, Smooth Cayenne, Providence and Charlotte Rothschild. This district also is not very suitable for pines, and in 1873 they were transferred to the newly acquired land at Hope.

In the Annual Report on the Public Gardens and Plantations for the year ended 30th September, 1880, it is stated that several varieties of the more esteemed Pine-apples were being propagated at Hope, and large numbers were being distributed among cultivators who desired to try this small, but apparently remunerative industry. The Report goes on to say that "The example of one enterprising settler who has realized, according to very reliable data, at the rate of nearly £80 per acre* has been the means of stimulating others to take up pine growing."

In the Annual Report for 1882, we read that in order to assist the industry, the Director of Public Gardens and Plantations obtained through the Royal Gardens, Kew, a selection of all the best Pines under cultivation in England, such as Lord Carrington, Smooth Cayenne, Lady Beatrice, &c., and from the Bahamas, the "Scarlet" and "Cuban" Pines, which then obtained so much favour in the New York market. The Report for the following year states, that a well-established plot consisting of 3,000 plants of Ripleys, 1,300 Sugar-loaf, besides a select series of Cuba, Queen, Lord Carrington, Lady Beatrice, Smooth Cayenne, Pitch Lake (Trinidad), &c., existed at the Hope plantation, and the produce that year was expected to reach 1,000

* According to Mr. Joseph's own statement "£200 and more from 1¼ acres per annum."

pines. The same Report states that 'For export parposes the more common kinds, such as the Jamaica Black Pine, appear te be in greater request than the Ripley, as the latter does not travel so well."

The Report for 1884 gives the following list of varieties then grown at Hope:—"White Ripley, Black Ripley, Sugar-loaf, Prince Albert, Montserrat, Cuban, Providence, Scarlet (Queen), Trinidad (Pitch Lake), Black (Antigua), Queen, Lady Beatrice, Smooth Cayenne, Thompson's (smooth) Cayenne, Moscow Queen, Lord Carrington, and Enville Queen." Many of these were obtained, through the Royal Gardens, Kew, from Windsor Castle, and from Lord Carrington's nurseries.

In the same Report the Director states "I am glad to report that the cultivation of this valuable and luscious fruit is greatly extending, and that the exports shew a marked increase on those of previous years. In the neighbourhood of all ports and especially where the soil is of a free, sandy or gravelly nature, affording good drainage, pine-apples might be extensively planted."

In the Report for 1896-97 the Superintendent of Hope Gardens draws attention to the markings on the leaf of the Green Ripley, and points out that by carefully studying these markings, plants producing poor, and generally worthless fruits, may be detected at an early stage of their growth, and discarded. He says "the Green variety has a pale green leaf, with red stripes situated on different parts of the leaf, the stripes being very pronounced in some plants, varying from a dark red stripe an inch in diameter to none at all. As far as my observations go at present it is only when the Green variety has the broad red stripe, and that situated in the centre of the leaf, that the plant is worth growing; the totally green-leaved plant, or the plant with a narrow stripe, especially when the stripe is on the edge of the leaf instead of in the centre, is not worth anything, the fruit produced usually having holes near the base into which ants creep, and by eating the fruit start it rotting."

He continued his observations, and in the next Report he states "The plants have been kept under strict observation with a view to determine what difference might be made by selection and cultivation. Plants have been propagated, by slips only, of fifty-five plants, thus raised from plants with correct markings which are now about a year or nine months old. Twenty-three have developed bad markings, *i.e.* red marks on outside of leaves; thirty-two plants have the correct markings. Of eleven plants raised from parents with markings on the outside of the leaf as well as in the centre, ten have developed bad marks, one only developing correct marks. Of seventeen plants raised from parents with markings on the outside of the leaf only, fifteen have developed bad marks, and two have leaves devoid of colour. Another curious thing noted is that, in the two latter instances, in some cases the main stem has failed to develop, assuming a twisted form, and developing side shoots only. Five plants of the eleven mentioned as having markings on the outside of the leaf, as well as in the centre, have degenerated in this way, and three out of the batch of seventeen. None of the plants raised from parents with correct markings have degenerated in this way." He further states that "Artificial manure has proved of the greatest value, increasing the vigour of the plants wonderfully, and adding nearly 1½ pounds to

the size of the fruits, as well as hastening their ripening by fully two weeks."

In the Report for the following year the Superintendent in continuation of his remarks on correlation of the colouring of the leaves and good fruits states "Of the fifty-five plants of the Green Ripley pine with red markings in the centre of the leaf only, ten have fruited, every fruit being a good one free from blemish; the remainder of the plants are now fruiting, but it cannot be determined whether these will be perfect until they ripen. No more of these plants have developed red markings on the side of the leaf *

"Of the eleven plants from parent with red markings on the outside of the leaf as well as in the centre, two have produced inferior fruits cracked near the base and exuding gummy matter which attracted large quantities of the black stinging ants, these fruits are quite uselesss; three have produced little knobs; the remainder of the plants are just commencing to fruit, but are not sufficiently advanced to enable us to form an opinion as to the quality.**

"Of twenty-seven plants with the markings on the outside of the leaf only, seven have produced little knobs, eleven have simply grown with the leaves twisted round in the centre of the plants and developed side suckers as though they had fruited; four have produced fruits which were of fair quality, although very small; and four plants produced small bad fruits,—cracked and exuding gum.

"The greatest care should be taken to propagate plants from those having the red colouring matter well developed and in the centre of the leaves only; plants with faintly coloured or colourless leaves, or plants having leaves with the red colour on the edge of the leaves, should be avoided.

"Red Ripley: Since observing the variation in the colouring of the Green Ripley Pine Apples, I have also noticed that some hing of the same kind occurs in the Red Ripley. When the colouring of the leaves is particularly bright, and the leaves have not the fine bloom observable in the best type of plant, it often produces an abortion similiar to those produced by the green variety when badly marked."

In the Report by the Director 1899-1900, the question of proper distances in planting is discussed. He states "we first started to plant at 3 feet apart in the rows, with rows 5 feet apart, thinking that at this distance it would be possible to keep the land clean by cultivators drawn by mule or horse, and so reduce the cost. This was quite feasible while they were in the "plant" stage, but as the plants ratooned, the fruits on the side shoots weighed them down, breaking off many, and exposing the side of the fruits of all to the sun, causing "sun burn." Other distances were tried, until it was finally decided that 2 x 3 feet was the proper distance, the reason being that although the hand cultivation necessary for the first year's growth is expensive by the second year the pines so shade the land that there is little or no growth of weeds beyond a few climbers. The plants are close enough together to prevent leaning and consequent sun burn."

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* All produced good fruit.

** Two of the remaining six produced little knobs, the other four rather small fruits cracked at the base.

In this same Report the following list of varieties grown at Hope Gardens is given. "Green Ripley Queen, Red Ripley Queen, Enville, Golden Queen, Smooth Cayenne, Black, Abbaka, Cow boy, Sugar-loaf, Moscow Queen, Cheese, Charlotte Rothschild.

Further, the Superintendent makes the following observations on pine-apples in the English market "The one pine-apple being sold in England is the Smooth Cayenne, but not as many people would have us believe, on account of its superior quality. The chief reason it sells so well is that it is a good looking pine, a fruit of good size, fine colour, and a handsome top, the weight ranging from 3 to 8lbs, but they average about 4 to 6lbs., larger not being required in England. The second reason for the Cayenne selling better than the much finer flavoured Ripley, is that it gets to market in better condition. Many dealers lost money over the Ripleys' being black in the centre, although apparently good on the outside. Mr Geo. Munroe of Covent Garden stated that if Ripleys could be got to market in good condition, they would run the Cayennes out of the market There is a good market in England for pine-apples at all seasons, a three-pound fruit will always fetch 4/ retail if in good condition; fruits weighing 5½ to 6lbs., if not too plentiful, sell retail at 8/ to 10/. There is a good demand for pines before the St. Michael's fruit arrives, which is generally about the beginning of June, although they are by no means plentiful before August."

The following is a list of varieties of Pine-apples now grown in Jamaica.

1. Ripley Queen, Red.
2. Ripley Queen. Green.
3. Bull-head. syns. *Man O'War, Red Spanish* of Florida and the Bahamas.
4. Sugar-loaf.
5. Cow-boy. syns. *Crab Pine, Mammee Pine.*
6. Cheese. syns. *Red Jamaica, Red Pine, Brick Pine.*
7. Black. syns *Black Jamaica, Black Spanish,*
8. Jerusalem. (This has complete miniature pines growing around the base of the main fruit).
9. Smooth Cayenne.
10. Abbaka.
11. Charlotte Rothschild.
12. Golden Queen.
13. Enville City.
14. Porto Rico.
15. Moscow Queen.
16. Sugar.

There are other doubtfully distinct varieties, or forms of well-known varieties grown in some districts, e g. "Sam Clark" found in the Parish of St. Catherine, and "Goffe" found in the northern coast lands in the Parishes of St. Mary and Portland There is very little doubt that when all the varieties or forms are brought together, and grown in the same locality under exactly similar conditions, that the slight differences which are now considered sufficient to warrant a distinctive name, and which are due to differences in soil, moisture, and temperature will disappear, and the present list of varieties in Jamaica

will probably require to be shortened. It is a well-known fact that the same variety is often known by different names in diffsrent districts. The Secretary of the Agricultural Society states that the following varieties, placed in order of merit, are at present considered the best for export, having realised the highest prices in London this year :—

Smooth Cayenne.	Black Pine.
Abbaka,	Bull-head.
Ripley,	Sugar-loaf.

"Sam Clark" (this is probably the same as Cheese Pine.)

The three latter are of equal merit.

The Hope Experiment Station is now experimenting in cross fertilising the Ripley with the Smooth Cayenne It is thought that if a cross could be obtained that would combine the size, shape, general appearance, and keeping qualities of the Smooth Cayenne, with the exquisite flavour of the Ripley, an ideal Pine for export would be the result.

The following Table shows the numbers and values of Pine-apples exported each year from 1876 to 31st March, 1901 :—

Years.	Quantities : Dozs.	Values £.
1876	195	48
1877	33	8
1878	1,140	341
1879	1,908	381
1880	3,480	522
1881	5,586	698
1882	8,887	1,111
1883	7,723	1,158
1884	14,070	2,111
1885	8,883	1,443
1886	9,557	1,434
1887	8,289	1,243
1888	9,812	1,472
1889	8,293	1,037
½ Yr. 1890	860	140
1890-91	10,527	1,579
1891-92	10,294	1,287
1892-93	6,828	853
1893-94	5,403	675
1894-95	4,939	617
1895-96	4,192	524
1896-97	5,543	693
1897-98	7,698	962
1898-99	3,114	402
1899-1900	6,086	761
1900-1901	7,511	1,033

This fine fruit has been known here for about 200 years, but it is only within the last 25 years that it has been cultivated to any extent, and within the last 5 years probably more time and money has been spent on this cultivation than at any previous period.

From reliable information received on the subject, we estimate the approximate area now under systematic cultivation at 200 to 250 acres, and this is being rapidly increased. To this area should be added probably 20 acres grown in small irregular patches. This might be extended to an almost indefinite extent, if good and steady markets were found for the fruit produced. The most common varieties appear to be Bull-head and Sugar-loaf, but under systematic cultivation they come in the following order:—(1) Ripley, (2) Smooth Cayenne, (3) Abbaka, (4) Bull-head, then follow small numbers of other sorts.

The cultivation of the Pine-apple has never been in such a promising condition in Jamaica as at present The industry is in the hands of intelligent growers who are determined to do everything that is possible and reasonable to make it a commercial success.

With at least one steamer per week to England, and usually several steamers per week to various ports in the United States, there is every reason to hope that the trade in Pine-apples will soon become of very considerable importance. In addition to the export trade, there is a good local demand for this splendid fruit, especially the delicious Ripley varieties.

Cultivation.

The best soil for pine apples is a well-drained, sandy loam. Red clay can be made suitable by thorough tillage, the addition of lime, and artificial drainage. Pines are very impatient of excessive moisture, and good drainage, either natural or artificial, is essential to the successful cultivation of this crop

The site having been selected (it should, if possible be on sloping ground), the land should be weeded and cleaned, then forked or ploughed to the depth of a foot or more, the deeper the better, as every crop benefits by deep cultivation. It should then be thoroughly broken up by means of a cultivator or harrow, or both where these can be used.

Where it is not practicable to work plough and cultivator the Assam fork should be used, first to turn up the soil, then to break it up fine.

In districts where the average rainfall exceeds 50 inches per annum. it is advisable to plant in raised beds

These beds should run in the same direction as the natural slope of the land, and may be 10 feet wide, which will be sufficient space for five rows of suckers 2 feet apart, leaving a margin of 1 foot on the outside of the two outer rows. Between the beds there should be a trench about 1½ feet wide which will serve as a drain, and also as a path to enable workers to weed the beds without trampling them.

In selecting suckers, take those that are 12 to 15 inches high The lower leaves should be pulled off, to allow the young roots to push freely, and the base of each sucker should be cut crosswise with a sharp knife, making a clean cut.

Having prepared the land, and the suckers for planting, the beds or grounds should be lined at distances of two feet apart, and the suckers should be carefully planted at distances of two feet in the row.

At this distance four square feet of ground will be allowed to each plant. Some planters recommend 3 feet between the rows, and 2 feet from plant to plant in the rows, but the tendency now is to plant closer, as it has been found in close planting that the suckers support each other and are not liable to be blown over when in fruit, as is so often the case when more space is allowed; also that the plants in time completely cover the ground and prevent the growth of weeds to a considerable extent.

In planting, make holes at the proper distances, and put the suckers in just deep enough to cover the naked base of each, then draw in the earth and press firmly around them. The ground should be kept free from weeds, and the surface open, by means of a Dutch hoe.

Manures. If land is planted that had previously been used for several years to pasture stock, and the soil is good sandy loam, manure will not be necessary for a few years; on the other hand, if it is arid and poor, it would be well to fork in, or plough in a good dressing of farm-yard manure when breaking up the soil, 6 months or so before planting, and give a top-dressing of wood-ashes which should be lightly raked in after the plants have started to grow. Artificial manures for pine-apples are now offered for sale, and are largely used by growers who wish to force their crops. In clayey soils, the application of lime, when preparing the land for planting, is highly beneficial Soils that have become exhausted by other crops may be made suitable for pines by growing a crop or two of cow-peas, and ploughing these in when they are in flower.

The best time to plant pines is July–August; good, strong suckers put in at this time of the year, will fruit in 9 to 12 months from time of planting. If planted earlier or later in the year, the suckers will take longer to fruit, 15 to 18 months or more.

YIELD OF RUBBER.

Although we have on several occasions given full particulars concerning rubber-planting, yield of rubber, &c., we have repeated inquiries as to the net returns which may be expected from a plantation. Perhaps the following letter addressed to the *India Rubber World* by Mr. A. H. Berkhout, late Conservator of Java Forests, will convey to intending rubber-planters the necessary information. Mr. Berkhout writes :—

In *The Indian Forester* (Vol. XXIV., page 160*). I presented some facts in relation to the oldest india-rubber plantation in the world, which is located on the Pamanukan-Tjiassem estate, in the Residence Krawang, in Java. At that time I wrote that the plantation came into existence in the year 1872, basing my information on personal conversation with the owner of the estate, but the opinion of the present chief overseer, Herr van Henkelom, seems to be that the plantation dates from the year 1864.

The young plants of *Ficus elastica* were obtained from the adjacent forests, by cuttings of branches, or by mareotting the uncultivated

* Quoted in *The India Rubber World*, 1st August, 1898.

trees, an operation to which the inhabitants of Java frequently resort. The before-mentioned rubber trees are especially adapted to the process of marcotting. All that is necessary is the removal of a strip of bark ¼ inch wide, and to bandage the wound with earth. After about fifty days, roots will appear through all sides of this ball, which can then be cut off. It is advisable before planting these young plants, which are about 20 inches in height, to place them, or rather nurse them, in rich, well-shaded soil for a period of about fifty days, in order to heal the cut thoroughly.

It is my opinion that the original cost of this plantation on the Tjiassem estate was not very much, because the *Ficus elastica* was planted about 8¼ yards apart each way, or seventy-two to the acre, within coffee plantations which were no longer productive, and required not much cultivation, I estimate the cost of the plantation at about 29s. per acre. Altogether 72½ acres, embracing 5,200 trees, were planted.

The first tapping was done in 1886, and the following figures will give the details :—

Years.	Pounds.	Average Ounces per Tree.	Value.	
			£	s.
1886	5,512	17	572	0
1887	4,954	15	518	4
1888	1,514	4	158	4
1890	3,307	10	345	6
1891	6,113	18	371	6
1892 ...	5,992	18	245	8
1895	3,197	10	394	6
1896	3,113	10	312	2
1897	6,731	21	729	6
1898	6,731	21	842	6
Total ...	47,164		4,490	8

Tappings could not be made in every year. In thirteen years (in three of which the trees were not tapped) a total of 47,164 lbs. was harvested, an average of 3,628 lbs. per year, or 10 ozs. per tree per year. During the four years, 1895-98, the average was 4,943 lbs., or 15 ozs. per tree. The yield per acre, therefore, from 1886 to 1898 averages 50 lbs., and from 1895 to 1898, 68 lbs.

The figures given above, by the way, in the column headed "Value" must be understood as referring to the income to the planter after deducting all expenses, not only of harvesting the crop, but also the initial expenses and the yearly expense for care of the plantation. From the information supplied to me in regard to the prices obtained for the rubber, I should infer that the yearly expense for the last four years covered by the table had amounted to an average of £2 10s. per acre per year.

An analysis of the figures above given will show an average yearly net profit of £8 3s. 9d. per acre, the figures for 1898 showing a profit per acre of £12 1s. 8d.

With respect to the possible yield from *Ficus elastica*, it may be

mentioned that Herr Mulder, in Sudimara, (West Java) obtained in in 1897 from three trees 105·6 lbs. and twenty months later from the same trees 99 lbs. This is, respectively, per tree 35½ lbs. and 33 lbs.

YIELD OF RUBBER IN MEXICO.

R. P. Probasco, of Chicago, favours *The India Rubber World* with the results of tapping cultivated *Castilloa* rubber trees by A. B. Coate, superintendent of La Soledad Plantation, on Trinidad River, Isthmus of Tehuantepec. Mr. Probasco received four specimens—

1. Weight, 3 lb. 2 oz.; collected from three trees, in diameter 16, 12½ and 14 inches.
2. Weight, 1 lb. 2 oz.; yield of one tree, 12 inches in diameter.
3. Weight, 1 lb. 9 oz.; yield of one tree, 11½ inches in diameter.
4. Weight, 2 lb. 4 oz.; yield of one tree, 18 inches in diameter.

Total weight, 8 lb. 1 oz., yield of six trees, gives an average of 1 lb. 5¼ oz. per tree. None of the trees is over eight years; some of them only six. Rain fell while the trees were being cut, washing away some of the rubber milk, and various other unfavourable conditions existed.—(*Queensland Agricultural Journal.*)

THE ALMOND BAG WORM.

A correspondent has sent specimens of the Almond Bag Worm attacking the Orange tree. No record has been made of its having been found before on the orange.

There is a note in the Journal of the Institute of Jamaica for August, 1893, on this insect. It quotes from Mr. Bowrey's Report as Curator for year 1879-80:

"The curious 'case' caterpillar, of which I have secured a specimen of the male moth which is winged, and also of the female which is apterous and never leaves the 'case' formed by the larva. This is the caterpillar which was noted on almond trees shortly after the August hurricane This is its ordinary food plant, and I can only account for its being specially noted in August last by supposing that the trees on which it feeds being blown down it was brought under popular notice. For years I have seen it on almonds, and I doubt if it has been as plentiful this year as it usually is. Its 'case' so exactly resembles in colour and texture the small branches of the almond as to pass unnoticed except special attention be called to it."

Prof. C. H. T. Townsend proceeds as follows, and then gives an exact description of the insect, probably *Oiketicus abbottii* Grote:

"A large number of these small bag-worms were found on an almond tree in the Marine Gardens, in Kingston, on June 24, 1893. Individuals of all sizes occurred, from tiny to large and evidently fully grown ones. The largest ones were found attached very strongly to the under side of the branches in places, where they were with great difficulty detached owing to the great strength of their silk. The smaller growing ones were found on the leaves, clinging to the underside of the latter in which they eat irregularly round holes, which they gradually enlarge. This gives the foliage the appearance of having been raked and riddled with shot of various sizes."

PROTECTION OF TREES AGAINST ANTS.

Ants cause so much trouble and loss especially to citrus groves that any suggestion of a remedy will doubtless be welcome to planters. The following paragraph is taken from the *Queensland Agricultural Journal*. The method is promising, as it is well known that the castor oil plant is most repugnant to insects.

"Many a freshly grafted bud on an orange tree has been destroyed by ants, which, with some other insects, are the bane of budders. An American fruit-grower has discovered a plan by which, he says, ants may be kept in their place. His plan is to saturate wool strings with castor oil, and tie these tightly round the trunk or limbs of the trees which have been budded. The ants go up as far as the strings, but none were seen to cross one of the bits of wool. Cotton strings will not do, and experiments with other oil have not been successful. Woolen yarn must be used. The same treatment is effectual on other trees."

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SEEDS.

From Botanic Department Trinidad—
Petrea alba, erecta.
From Reasoner Bros. Oneco, Florida—
Cocos Alphonsii.
From G. S. Jenman, Esq., British Guiana—
White Nymphæa.
From Hon. Oscar Marescaux, Cherry Garden—
Bombay Mango.
From Royal Gardens, Kew—
Erythrina sp.
Kalanchoe crenata
Mammillaria stellata
Tobacco.

PLANTS.

From Hon. Oscar Marescaux, Cherry Garden—
Bulbs of Zephyranthes flava.
From G. S. Jenman, Esq., British Guiana—
Tubers of red Nymphæa
" white do.

HERBARIUM.

From Hon. Oscar Marescaux, Cherry Garden—
Sp. of Tacsonia.
From B. S, Gosset, Esq. Farm Hill—
Blue Mountain Coffee (cured.)

[Issued 4th Sept., 1901.]

JAMAICA.

BULLETIN

OF THE

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New Series.] OCTOBER, 1901. Vol. VIII Part 10]

THE BANANA SOILS OF JAMAICA.

By H. H Cousins, M.A., F.C.S., Government Analytical and Agricultural Chemist.

I. Portland and St. Mary.

The value of soil analysis as a practical guide to the cultivator has often been exaggerated, and it would be a most unsound policy to attempt to deduce practical measures from analyses only. When such analyses are carefully carried out with the precautions and methods which the latest experience of Agricultural Chemists have devised, and interpreted, not in an absolute, but in a comparative manner; and further when associated with field experiments and careful records of crop returns under various treatments, soil analyses may be of the greatest value in giving a short cut to the vital conditions of economic production.

In publishing these first results, it must be understood that they are but the preliminaries to a wider survey of the soil conditions of Jamaica and that they will receive a more practical interpretation in the light of the field experiments which the Board of Agriculture has now instituted to cover all the chief cultivations of Jamaica.

The figures and the observations that follow them in each case speak for themselves. The soils from Burlington and Quebec Park are truly extraordinary. Despite a century of cane cultivation and a long series of banana crops, these soils are still in a very high state of fertility. 'Tomb Piece' at Burlington is an agricultural curiosity. It is at least 30 times as rich as good average wheat land in England.

The Phosphoric Acid is, I believe, a record. The amount was so enormous that the analysis was repeated and carefully checked before it was accepted. There is a mine of wealth in these soils which needs but energy and enterprise to dig it out and realise its possibilities.

SOIL ANALYSIS.

Reference Number—2 From Hon R. P. Simmonds, Port Maria.
Source Details—A Soil growing bananas at Quebec Park.

Depth of Sample—9 inches A_1 (surface soil) 9-24 in. A_2, 24-36 " A_3, 36-48 " A_4 } Subsoil

Physical Analysis.

PER CENT.

		A_1	A_2	A_3	A_4	
	Stones ...	Nil.	1.09	1.05	Nil	
	Gravel ...	1.33	5.02	5.02	4.37	Fine Earth.
	Sand ...	1.29	7.93	3.88	7.46	
	Fine Sand ...	30 71	37.71	38.47	36.88	
	Silt ...	13.25	25.98	29.68	27.33	
Agricultural Clay	Fine Silt ...	33.99	12.92	12.54	14.35	
	Clay ...	11.06	2.14	2.19	2.27	
	Combined water, Organic matter	8.37	7.50	8.22	7.34	
	Total ...	100.00	100.00	100 00	100.00	

	Per Cent.
Retentive Power for water (A_1) ...	53.00

Chemical Analysis A_1.

(Soil passed through 3 m.m. Sieve, dried at 100°C.)

Insoluble Matter ...	68.07
Soluble in Hydrochloric Acid	–
Potash ...	.9249
Lime ...	1.62
Phosphoric Acid ...	.138
Carbonic Acid as Carbonate of Lime	.506
Combined Water and organic matter	7.93
Humus (soluble in Ammonia)	3.58
Nitrogen ...	.196
Hygroscopic Moisture ...	7.62

Fertility Analysis.

Available Potash ...	0.0272
Available Phosphoric Acid	.0096

Observations.

The surface soil is a loam of ideal composition and high fertility It is so rich in all the elements of fertility that it is doubtful whether any manures are at present required to produce full bunches of bana-

nas. Such a soil will repay the highest cultivation, and demands good drainage as a first essential. The subsoil becomes gradually lighter than the surface soil, the proportion of clay diminishing, while that of the coarser free draining particles increases. Drains of a minimum depth of 3ft are indicated as desirable. The soil is not sour, and I do not think that it is likely to be benefitted by a dressing of burnt lime. This soil would react with superphosphates or basic slag should it become necessary to manure the bananas I expect that this soil would carry full bunches of bananas for several years without the use of any fertilizers, provided good cultivation is maintained. Any agriculturist with such land at his command should find its cultivation both encouraging and profitable.

SOIL ANALYSIS.

Reference Number—3. From Hon. R. P. Simmonds, Port Maria.
Source Details—B. Soil at Quebec Park growing Bananas.
Depth of Sample—9 inches Tilled surface soil.

Physical Analysis.

			Per Cent.	
	Stones	...	–	
	Gravel	...	.23	Fine Earth
	Sand	...	.21	
	Fine Sand	...	33.19	
	Silt	...	31.18	
Agricultural Clay	Fine Silt	...	21.35	
	Clay	...	5.34	
	Combined water, Organic matter.	...	8.50	
	Total	...	100.00	

	Per Cent.
Retentive Power for water ...	57.00

Chemical Analysis.

Soil passed through 3 m.m. Sieve, dried at 100° C.)

Insoluble Matter ...		49.35
Soluble in Hydrochloric Acid		–
	Potash ...	.6446
	Lime ...	13.59
	Phosphoric Acid ...	.157
	Carbonic Acid as Carbonate of Lime	23.33
Combined Water and organic matter		9.18
Humus (soluble in Ammonia)		4.96
Nitrogen ...		.1431
Hygroscopic Moisture ...		7.53

FERTILITY ANALYSIS.

	Per Cent.
Available Potash ...	0.0024
Available Phosphoric Acid	0.0048

OBSERVATIONS.

A marly loam of high fertility. It contains much chalk and a considerable reserve of plant-food. The amount available for present use is however, not very high as regards phosphate and potash and markedly below that in soil A. Should the grade of fruit fall off, a dressing of 4 cwt. superphosphate and 1 cwt. sulphate of potash per acre should be applied. Basic slag is not suited to this soil. Green dressings would be of benefit. The soil is not sour. Drainage should be carefully attended to, although the soil is naturally more free draining than soil A.

SOIL ANALYSIS.

Reference Number--4. From Hon. R. P. Simmonds, Port Maria.

Source Details { C1 Soil from Quebec Park in Bananas 18 years, has always, and still grows good fruit.

Depth of Sample—9 inches. Tilled surface soil.

PHYSICAL ANALYSIS.

			Per Cent.	
	Stones	...	Nil	
	Gravel	...	0.24	Fine Earth.
	Sand	...	1.41	
	Fine Sand	...	29.86	
	Silt	...	42.46	
Agricultural Clay.	Flint Silt	...	15.16	
	Clay	...	3.04	
	Combined water, Organic matter	...	7.83	
	Total	...	100 00	

	Per Cent.
Retentive Power for water ...	55.5

C_2 C_5 C_4 (subsoil moderately porous for depth of 4 feet).

CHEMICAL ANALYSIS.

(Soil passed through 3 m. m. Sieve dried at 100° C.)

Insoluble Matter ...		42.93
Soluble in Hydrochloric Acid		—
	Potash ...	0.7453
	Lime ...	17.22
	Phosphoric Acid ...	.1223
	Carbonic Acid as Carbonate of Lime	26.92
Combined Water and organic matter		8.38
Humus (soluble in Ammonia)		2.50
Nitrogen ...		.1161
Hygroscopic Moisture		6.96

FERTILITY ANALYSIS.

Available Potash ...	0.0048
Available Phosphoric Acid	0.0008

OBSERVATIONS.

This soil, a marly loam is rather lighter in texture than soil B., but otherwise is fairly similar in general composition. The remarks made on soil B., apply generally to soil C. The most striking fact brought out is the very great reduction in *available phosphoric acid* and to a less extent the nitrogen, in the soil through continuous cropping. A portion of this land should be kept under bananas without manure, to determine the minimum limit of available phosphoric acid required to produce full bunches. It would seem that the soil is now on the verge of exhaustion as regards phosphoric acid. A dressing of 4 or 5 cwt. of superphosphate per acre should have a marked effect. The humus is getting low and the nitrogen is below that in the other soils. A green dressing of cow-peas should effect an improvement of these two factors of fertility.

A further sample of soil is required when the untreated portion shows decided signs of being exhausted.

SOIL ANALYSIS.

Reference Number—5.

Source Details—"Stiff soil from St. Mary where Bananas have not done well."

Depth of Sample—9 inches.

PHYSICAL ANALYSIS.

			Per Cent.	
	Stones	...	nil	
	Gravel	...	0 26	
	Sand	...	0.94	
	Fne Sand	...	22.07	
	Silt	...	22.87	Fine
Agricultural Clay	Fine Silt	...	24.11	Earth
	Clay	...	17.45	
	Combined water, Organic matter.	...	12.30	
	Total	...	100.00	

		Per Cent.
Retentive Power for water	...	63

CHEMICAL ANALYSIS.

(Soil passed through 3 m.m. Sieve, dried at 100° C.)

Insoluble Matter	...	54.22
Soluble in Hydrochloric Acid		45.88
Potash	...	.2907
Lime	...	.2437
Phosphoric Acid		.0254
Carbonic Acid as Carbonate of Lime		.120
Combined Water and organic matter		12.30
Humus (soluble in Ammonia)		3.15
Nitrogen	...	.2107
Hygroscopic Moisture		9.66

FERTILITY ANALYSIS.

Available Potash ...	0.0150
Available Phosphoric Acid	0.0329

OBSERVATIONS.

This soil presents a normal composition for a fertile soil with the following exceptions:—

The *Carbonate of Lime* is so low that efficient nitrification can not take place.

The *total Phosphoric Acid* is very low, although a considerable proportion of it is in a readily available state. This soil would very rapidly suffer from exhaustion in this respect. Otherwise the soil contains an adequate supply of plant food.

Practical suggestions:—

1. Drainage is an obvious necessity, and for bananas heroic efforts in this direction would be necessary.

2. Applications of lime or marl are greatly needed. A top dressing of 10 tons marl per acre or of two half tons of burnt lime (in separate applications) per acre should have a marked effect.

3. I recommend the regular use of basic slag at the rate of 5 to 7 cwt. per acre as a source of phosphoric acid and as a source of lime to the soil.

4. The present store of humus should suffice for two or three crops; green dressings of cow-peas or other leguminous crops should be employed when necessary.

5. I am of opinion that this soil requires very thorough management and a scrupulous attention to the foregoing points in order to grow bananas successfully. This soil is vastly inferior naturally, to such soil as those of Quebec Park and Burlington where Bananas grow freely and readily.

SOIL ANALYSIS.

Reference Number—6 Burlington A. From Hon. H. Cork.
Source Details—Surface soil growing bananas. High land. Type of splendid banana soil "Tomb Piece."
Depth of Sample—9 inches.

PHYSICAL ANALYSIS.

			Per Cent.	
	Stones	...	–	
	Gravel	...	0.41	Fine Earth.
	Sand	...	5.46	
	Fine Sand	...	28.89	
	Silt	...	23.65	
Agricultural Clay	Fine Silt	...	13.77	
	Clay	...	2.72	
	Combined water, Organic matter	...	25.10	
	Total	...	100.00	

		Per Cent.
Retentive Power for water	...	44

CHEMICAL ANALYSIS.

(Soil passed through 3 m.m. Sieve, dried at 100° C.)

Insoluble Matter ...	27.870
Soluble in Hydrochloric Acid	72.130
Potash ...	.6796
Lime ...	1.379
Phosphoric Acid ...	2.760
Carbonic Acid as Carbonate of Lime	.600
Combined Water and organic matter	25.100
Humus (soluble in Ammonia)	9.86
Nitrogen ...	.7036
Hygroscopic Moisture ...	24 860

FERTILITY ANALYSIS.

Available Potash ...	0.0571
Available Phosporic Acid	0.0908

OBSERVATIONS.

This is a remarkable soil. It contains a large proportion of vegetable mould, and is yet possessed of a desirable proportion of fine soil particles It is both free-draining and retentive of moisture. An ideal medium for the root system of the banana. The subsoil is porous and self-draining. The proportion of nitrogen and phosphoric acid is most extraordinary, the former being 7 times and the latter 30 times greater than good average arable land in England. The available potash and phosphoric acid are both high. This is a typical specimen of a Jamaica soil specially prepared, as it were, for the kindly growth of the banana. I can suggest no manures as desirable or necessary, and conclude that cultivation alone will suffice for full crops of standard fruit for many years to come.

SOIL ANALYSIS.

Reference Number—7. Burlington B. from Hon. H. Cork.

Source Details. Surface soil growing bananas well. Flat land. Type of good average banana land. 'Clarke Piece.'

Depth of Sample—9 inches.

PHYSICAL ANALYSIS.

			Per Cent.	
	Stones	...	Nil	
	Gravel	...	3.23	Fine Earth
	Sand	...	7.97	
	Fine Sand	...	44.38	
	Silt	...	30.20	
Agricultural Clay.	Fine Silt	...	7.05	
	Clay	...	0 54	
	Combined water, Organic matter.	...	6.63	
	Total	...	100.00	

		Per Cent.
Retentive power for water	...	45

CHEMICAL ANALYSIS.

(Soil passed through 3 m. m. Sieve, dried at 100° C.)

Insoluble Matter ...	67.593
Soluble in Hydrochloric Acid	32.407
Potash ...	.572
Lime ...	1.881
Phosphoric Acid ...	.161
Carbonic Acid as Carbonate of Lime	.221
Combined Water and organic matter	6.63
Humus (soluble in Ammonia)	1.75
Nitrogen ...	.1184
Hygroscopic Moisture	4.898

FERTILITY ANALYSIS.

	Per Cent.
Available Potash	0.0210
Available Phosphoric Acid	0.0422

OBSERVATIONS.

This soil consists mainly of fine sand and silt and is naturally porous and free-draining. The subsoil is porous and readily permits a free passage for surplus rainfall. As a store of fertility this soil is markedly below "Tomb Piece." The humus and nitrogen are low for a banana soil. The carbonate of lime is also very near the minimum limit. The available phosphoric aicd and potash are above the average. This soil is fertile in its present state. but I imagine it will need assistance if bananas are to be grown continuously for a period of years. Cow-peas and marl are indicated as useful amendments to this soil. For the rest, cultivation and good plantation management should suffice.

SOIL ANALYSIS.

Reference Number—8. Burlington C., from Hon. H. Cork.

Source Details. Surface soil from land that does not grow Bananas. Plants give out when about to shoot. "Miller Piece"

Depth of Sample—9 inches

PHYSICAL ANALYSIS.

			Per Cent.	
	Stones	...	Nil	
	Gravel	...	0 52	Fine Earth.
	Sand	...	2.50	
	Fine Silt	...	46.47	
	Silt	...	33.74	
Agricultural Clay.	Fine Sand	...	10.95	
	Clay	...	trace	
	Combined water, Organic matter.	...	6.20	
	Total	...	100.38	

		Per Cent.
Retentive Power for water	...	46

CHEMICAL ANALYSIS.

(Soil passed through 3 m.m. Sieve, dried at 100° C.)

Insoluble Matter ...	68.150
Soluble in Hydrochloric Acid	31.850
Potash ...	0.445
Lime ...	2.120
Phosphoric Acid ...	0.134
Carbonic Acid as Carbonate of Lime	0.317
Combined Water and organic matter	6.20
Humus soluble in Ammonia	1.59
Nitrogen ...	0.1738
Hygroscopic Moisture	5.627

FERTILITY ANALYSIS.

	Per Cent.
Available Potash ...	0.0242
Available Phosphoric Acid	0.0311

OBSERVATIONS.

This soil is similar to that of "Clarke Piece" in general composition. It is a light free draining soil with a porous subsoil. It is below the aforesaid soil in fertility as for instance humus, potash and phosphoric acid, total and available. The percentage of carbonate of lime is also low. When "Clarke Piece" has been reduced to this state by continuous cropping there is every possibility of a failure of the banana crop. I recommend cow-peas, a dressing of 10 cwt. burnt lime or a fair application of marl and a top dressing of

3 cwt., superphosphate
1 " steamed bone flour } per acre.
1 " sulphate of ammonia

CATTLE FOOD.

The problem of the best food for stall-fed cows in dairies where grass is scarce in dry weather is one to which it is important that attention should be directed.

A commercial cattle-food is said to be largely composed of the carob or locust bean of the Mediterranean region, or of the guango bean imported from South America.

The guango is naturalised in Jamaica, the beans are well known to be a favourite food of cattle and horses, and valuable especially in times of drought. They should be collected as soon as they drop, and kept in a dry place where they will not become mildewy. If they get damp in the rainy season, they should be spread out at the first opportunity in the sun.

The value for cattle food is about the same as that of the carob. The analysis given below was worked out by Prof. Harrison of Dem-

erara, and published in a Report by Messrs. Jenman & Harrison on the agricultural work in the Botanical Gardens for 1890.

Composition of ripe Saman or Guango (Pithecolobium Saman) beans (pods and seeds):—

	In fresh state.	dried at 130° F.
Water ...	54·08	9 26
Glucose ...	10·85	21·45
Gums. pectose, etc. ...	8·89	17·58
Albuminoids ...	7·30	14·44
a. Oils, fats, etc. ...	76	1·51
Starch and digestible fibre	13·73	27.07
Indigestible fibre ...	2·96	5·85
Mineral matters ...	1·43	2·84
	100·00	100·00
a. Containing nitrogen ...	1·16	2·31

A plantation might be made of the Breadnut tree which also grows well in dry situations. Small branches make an excellent fodder, and so do the nuts which are produced in large quantities in September and October. The Ramoon might be grown also for the same purpose.

Leguminous plants which send down their roots long distances, like Alfalfa, are well worthy of a careful trial, as they stand drought very much better than grass.

HISTORICAL NOTES ON ECONOMIC PLANTS IN JAMAICA.

By the Editor and W. Harris, F.L.S.

III. Bananas.

Bananas and plantains, whether edible, or ornamental only, belonging to the genus Musa, are all natives of the Old World. Sloane says :— "This tree was no native in the West Indies, but brought thither "from the Canary Isles by one Thomas di Berlanga, a Friar, to Santa "Domingo in the year 1516, from whence they were sent to the other "Isles and Main, and they being very useful and taking extremely, "were planted everywhere. Oviedo, lib. 8 cap. 1, but in all proba- "bility this plant came first from Guiana to the Canaries"

The edible varieties cultivated now at Hope Gardens have almost all been received from Kew Gardens, either directly, or from the Botanic Gardens at Dominica. The following is a list :—

1 Almeido pisang.
2 Apple.
3 Champa.
4 Chinese or Dwarf.
5 Cinerea(Saharanpur).

6 Discolor.
7 Guindy (Ootacamund.
8 Jamaica or Martinique.
9 Kudjo Hudang pisang (Java).
10 Lady's Finger.
11 Lady's Finger (Panshonger).
12 Maas pisang (Java).
13 Martabanica.
14 Oleracea.
15 Palembang pisang.
16 Radji pisang.
17 Raja Siem.
18 Ram Kela.
19 Red.
20 Sereh pisang (Java).
21 Species from the (Congo, from M. Patin).
22 Susu pisang (Java).
23 Vittata

Jamaica or Martinique Banana.

The banana almost exclusively exported from this island is known in England and the States as the Jamaica banana, but it was known here at first as the Pouyat or Martinique banana. The following letters tell the story of its first introduction from Martinique :—

Kingston, 14th September, 1901.

DEAR MR. FAWCETT,

I sent my notes concerning the Banana Pouyat to Mr. Pouyat's grandson who now fills the office here of Registrar of Titles, and I have his reply confirming my notes and, which I now send you in reply to your letter.

The Banana in question was known here ever since I can remember as the "Banana Pouyat," and the name is still used by some. From 1796-97, to 1830, Kingston and the neighbouring parishes of Saint George, St. Andrew, and Saint Thomas-in-the-Vale were largely colonized by the members of refugee families from Haiti, who came over through the negro rebellion in that country. Kingston was almost a French town. My own family came over from Haiti at the same time. I remember another Banana which was brought over by (as it is said) a refugee of the name of St. Marie, who settled in the Above Rocks district of Saint Thomas, in St. Thomas. It is a coarser and smaller fruit than the Pouyat, with a flesh-coloured pulp. It is now sometimes seen in our markets, but it is not much cultivated. It was called from the country whence it was brought here "Figue d'Haiti."

With kind regards,

Yours truly,

HENRY VENDRYES.

Kingston, 12th Sept., 1901.

Dear Mr. Vendryes,

I have your letter of the 10th instant asking me for some information respecting the introduction into this Island of the Martinique Banana.

You are quite right in stating that it was my grandfather (whose name was John François Pouyat) who brought that fruit from the Island of Martinique, he did so in the early thirties of the last century.

John François Pouyat was born in 1780 at Limoges in France and his profession was that of a Botanist and Chemist. He went to Philadelphia (U.S.A.) where he had relatives (the D'Espinoses) about 1804 to 1806 and entered into business there as a Chemist—his first visit to Jamaica was in 1808-1809, to ask for the hand of a Madle. Lubin, the daughter of Louis Lubin a refugee from San Domingo who came to Jamaica about 1796-97—he Lubin became naturalized and bought a Coffee property called "Belle Air" in St. Andrew. On my grandfather's marriage with Madle. Lubin he went back to Philadelphia and remained there for some years returning to this Island about 1820 with his wife and children. After the death of Louis Lubin my grandfather acquired "Belle Air" through his wife, she being the sole surviving child and heiress of Louis Lubin. In the early thirties he went to Martinique (for what purpose I am unable to find out) and on his return, besides other plants, he brought the Martinique or Banana-Pouyat, a plantain called the "Tiger Plantain" on account of its black spotted appearance, (this plantain is still to be found in some parts of St Andrew), and another Banana of a small size with a thin pale yellow skin and of a luscious flavour, this last it seems has entirely disappeared.

The first Martinique Banana was planted at "Belle Air" and the first bunch of Bananas was sent to the then Agricuitural Society who awarded a prize of a doubloon to my grandfather for introducing it into the Island.

My grandfather died in 1857. I remember him distinctly as I was then 13 or 14 years of age. He had often told me that it was he who brought the Martinique Banana to Jamaica.

My mother who is alive and is 76 years old—and who married in 1843, my father Henri Pouyat, (the youngest son of Jean François Pouyat,) remembers also to have heard my grandfather say that it was he who brought over our Banana (of commerce) from Martinique.

I am unable to state whether he occupied any official position in France, America or any of the French Islands but in Jamaica he held no such position.

I am,
With kind regards,
Yours truly,
(Sgd.) Hy. F. Pouyat.

Export.

The fruit trade between Jamaica and the United States, which is now the most important industry in the Island, was started in 1869 by the efforts of Captain Bush, who after one or two experimental ventures, loaded seven vessels with bananas from Port Antonio. Capt. Baker afterwards went on with the work, and ten years later (1879) the value of this fruit shipped was £32,895. By the end of the next ten years (1889), owing to a subsidy of £5,000, granted by the Government to the Atlas Steamship Company, it had increased to a value of £252,114. At the end of the next ten years (1899), the value was £468,580. In the year ending March, 1901, the number of bunches exported was 8,248,485, of the value of £618,636, or about 33 per cent. of the exports of the Colony, (excluding gold and bullion,)—these were mainly shipped by the United Fruit Company, of which Capt. Baker is President.

The distribution was as follows :—

Where Exported.		Bunches.	Value.
United Kingdom	...	38,880	£2,916
United States	...	8,203,957	615,297
Canada	...	2,513	188
Bermuda	...	2,365	177
British West Indies	...	690	52
Cuba	...	80	6
		8,248,485	£618,636

In the early part of this year (1901), a subsidised line of steamers, (Messrs. Elder, Dempster & Co.) with specially fitted cool-air chambers, commenced running from Jamaica to England, mainly for the purpose of carrying fruit.

One of these steamers leaves every fortnight and proceeds to Bristol, whence the fruit is distributed to various centres in the United Kingdom. Each steamer takes, on an average, about 20,000 bunches of bananas in addition to other cargo As the trade develops, larger steamers will be employed, and one will leave each week.

CINCHONA BARK FROM JAMAICA.

In June last 290 Bags of Cinchona Bark from the Government Plantations were sold in the London market, realising the sum of £594 12s. 1d. The total weight of bark was 25,613 lbs, so that the average price per lb. is about 5⅝d.

The insurance, wharf charges, printing, advertising and brokerage amounted to £32 0s. 3d.; the freight and charges to £32 1s. 2d.; and cost of bags and carriage in Jamaica to £20 11s. 6d.

BANANA AS DIET IN TYPHOID CASES.

An American Doctor (Dr. Usery, of St. Louis), says the *Liverpool Journal of Commerce*, has lately confirmed the previously stated belief accepted in some medical quarters, in the value of the banana as a food for typhoid patients. During the progress of this malady, the use of solid food owing to the thinness of parts of the intestinal walls, is attended with danger; but it is asserted that the banana is both safe and beneficial, the stomach practically absorbing the fruit owing to its nature. It contains only about 5 per cent. waste matter, 95 per cent. possessing nutritive properties.

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SEEDS.

From G. S. Jenman, Esq., British Guiana—
Licuala grandis

PLANTS.

From Messers. Reasoner Bros. Florida—
Suckers of Porto Rico Pine-apple.
" " Red Spanish " "
" " Egyptian Queen "

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JAMAICA

BULLETIN

OF THE

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HISTORICAL NOTES ON ECONOMIC PLANTS IN JAMAICA.

By the Editor and W. HARRIS, F.L.S.

IV. THE MANGO.

The Mango is a native of the East Indies, but is naturalised or cultivated in most tropical and sub-tropical countries. It is an evergreen tree attaining a height of 30 to 40 feet, with a spreading, or rounded head of dense foliage which, in a young state, is of various beautiful rosy tints, purplish, &c., but finally it assumes a dark green hue, giving the tree a rather sombre aspect. It is a handsome tree, but too sturdy and low to be called stately. In the early morning the air is perfumed with the delicious fragrance of the small flowers which are produced in great profusion in branched panicles. It is now almost impossible to think of Jamaica without its mango trees. They are the principal feature in the landscape almost everywhere from sea-level up to 3,000 or 4,000 feet altitude.

To those who do not know the history of its comparatively recent introduction, it would appear to form a part, and an important and prominent part of the indigenous flora. Many of the old, scarred monsters, with huge trunks and limbs, and spreading heads, look as if they have braved the elements for a couple of centuries at least, and yet it is not 120 years since the first Mangoes were brought to Jamaica.

In 1782, Captain Marshall of His Majesty's Ship "Flora," one of Lord Rodney's squadron, captured a French ship bound from Mauritius to Haiti, and on board were found many plants and seeds of economic value, amongst them being the Mango, Cinnamon, and Jackfruit. The plants were all numbered, and No. 11. was the Mango which has since become so famous. The ship was sent as a prize to Jamaica, and Captain Marshall, "with Lord Rodney's approbation" deposited the collection of plants and seeds in the garden of Mr. Hinton East, afterwards for a time a public Botanic Garden, situated near Gordon Town, in the Parish of St. Andrew.

In 1794, Dr. Dancer had an advertisement in the Royal Gazette, offering 18 plants of Mango for distribution, 6 for each county. The Mango found a congenial home, and appears to have rapidly increased in numbers and variety of kinds, for we read in Lunan's "Hortus Jamaicensis," published in 1814, just 32 years after the tree was introduced, that it had "become one of the commonest fruit trees in Ja-

maica, in a great number of varieties." Even at this early date, we are told by Lunan that "this fruit is very justly and generally esteemed wholesome and agreeable; in some of the varieties it is indeed delicious. When taken from the tree before they are fully ripe, they make a good preserve, sweetmeat, or pickle; and, when brought to table cooked in puddings or dumplings, have a near resemblance in taste to apples. Hogs, as well as other animals, are very fond of this fruit, and in many places where they abound, are fed upon them. This plant is easily raised from the seed, but does not bear transplanting well, and will bear in three or four years; they bear abundantly, and make a beautiful appearance both when in flower and in fruit, and thrive well in almost every situation."

Varieties. In Macfayden's "Flora of Jamaica" published in 1837, we learn that in Mr. East's garden there was a large number of plants, producing several varieties of this fruit. "The rebeing a great number of plants producing several varieties of the fruit, they were regularly numbered. Hence two of the most esteemed sorts have since come to be known by the names of No. 11 and No. 32. The No. 11 is a flat-sided green fruit, of a delicious aroma, and an agreeable sub-acid taste. The No. 32 resembles it in form and fragrance, but is of a yellow colour, and possess a more luscious sweetness. Besides these, the following varieties may be noticed. 1. *Carrot Mango,* a large fruit, with the pulp hard, and in taste, somewhat resembling the root which gives it its designation. 2. *The Papaw Mango,* of the same size with the last, but the pulp is juicy, and to the taste a luscious sweet. 3. *Yellow kidney-shaped Mango,* a very good fruit. 4. *Green kidney-shaped Mango,* a fruit of a luscious sweetness. 5. *Tie-tie Mango,* so named from the branches of the peduncle being long, and supporting the fruit like a bunch of onions; rather an inferior fruit. 6. *Plum Mango,* a small variety of the fruit and scarcely eatable. 7. The *Parrot Mango,* an oval plump fruit, of a green colour with an erubescent tinge when ripe, juicy, with a somewhat turpentine flavour, subject to be infected with maggots. 8. The *Hard, or Turpentine Mango,* resembling the last, but of a yellow colour, with the pulp hard, and only fit for stock. 9. The *Finger Mango,* a long fruit resembling in shape the human finger, of no value. 10. The *Dwarf Mango,* growing in the upper mountains, size of a small plum, of no count as a fruit."

No. 32, mentioned above, does not now appear to be known.

In the report on the Botanic Gardens for 1869 we find that through the influence of Sir John Peter Grant, then Governor, two Ward's cases of grafted Mangoes arrived from India, viâ Kew, the first case with six varieties, in July, and the second in December with sixteen varieties. Of the first, five are thriving admirably; of the latter, twelve are safe and in good condition. The first were unnamed, but the latter consist of the following:—

Dalhogni	Goa
Madame (introduced to India from the Mauritius)	Langera
Khyroapatty	Soonderehaw
Bhadoorea	D'Cruze's Favourite
Bangalore	Agabey
Madras	Bombay

In the report for 1873, it is stated: "The numerous varieties of Indian Mango, imported in 1869, some of which now assume the aspect of trees, are capable of extensive propagation by grafting, and this will be resorted to next spring. Although the climate of Castleton is extremely favourable for the growth of these plants, the reverse is the case so far as the production of fruit is concerned, especially in the early stage of growth."

In the next Report we find it stated: "*New Mangoes*—Last Spring eighteen new mangoes were propagated by the process of inarching, the allied system of grafting not having been yet successfully pursued." And in the Report for 1876-77: "*Indian Mangoes*—Two dozen plants of the East Indian Mangoes have been propagated this season by inarching. They are worked on stocks of the common forms, the union of the scion and the stock is accomplished in six or eight weeks, and a further period of six weeks has to be allowed for the gradual severing from the parent tree; unfortunately the trees occupy a low, wet piece of ground, on the level and within atmospheric influence of the Wag Water River. The ordinary mangoes along the line of the river never, or very rarely, fruit; the East Indian trees have flowered regularly for several years, but only in a single instance has the fruit set."

The succeeding Annual Reports record that the Bombay Mangoes were steadily propagated by inarching, and distributed throughout the island. In 1884. grafted plants of the following varieties were received from the Botanic Gardens, Martinique:—

D'Or	Cedot
Julie	Sabot
Amelie	Crœsus
Freycinet	Poiget Dore
Martin	Jacot

Fifine Gabrielle

In his Annual Report for the year the Director writes: "It is often asked, can nothing be done with the thousands of tons of mangoes annually produced in this island and for the most part left to lie on the ground and rot for want of using? The mango tree in all its various forms has now been thoroughly naturalised in the island, and since 1790 it has spread spontaneously and abundantly everywhere. It especially affects land thrown out of cultivation and the sides of roads and streams where its seeds are cast aside by men or animals, and it practically re-clothes the hills and lower slopes with forest. It thus enables the land to recuperate its powers under its abundant shade-giving foliage.

"To the mango, possibly, more than any tree in the island (with the exception, perhaps, of the logwood) is due the reforesting of our denuded areas; and, as in consequence of the changes taking place in the climate indigenous plants are unable to maintain their ground, it is fortunate we possess in a vigorous and hardy exotic like the mango, the means for counteracting the baneful effects of deforestation.

"As to the utilization of the fruit of the mango on a large scale, there is a vast and practically untouched field here for the chemistry of organic products. Some would suggest that the best varieties might be canned or preserved for exportation, or made into preserves

and jellies; others that the grosser kinds might be utilized for the production by distillation of useful spirits; others that a starch compound might be prepared from the inner layers of the flesh next the seed; whilst lastly, I would venture to suggest that taking into account the present commercial value of glucose, the peculiar form of sugar which exists in grapes and other fruits, the ripe mango might be made to yield large quantities of this at a small expense.

"The fruit is very tender, and requires care and judgment in gathering, as well as in the necessary packing. Gathered a little before they are ripe, and kept in a cool storage there is no reason whatever to doubt that mangoes might become as common in the markets of London and New York as the pine-apple."

In 1887, the late Mr. John McLean of Cold Spring, presented 4 plants and 26 seeds of a superior variety of mango from Mexico. The plants did well, but the seeds were old and only two germinated.

In 1897, some of the mangoes from Martinique fruited, and one of these is described as "a fine, fibreless mango, but not equal to the Bombay mango introduced in 1869."

In the Annual Report for 1898-99, it is stated:—"The inarching of Bombay mangoes during the past year has been very successful, chiefly owing to the raising of better kinds of stocks after the methods mentioned in last year's Report. We have been able for the first time to keep the supply of grafted plants equal to the demand which is still small as these exquisite fruits are not well known, and we have a stock on hand of about 50 grafted plants"

"Seeds of Mexican mangoes, supposed to be something very superior have been received and a nice stock of plants raised." "Several plants of mangoes imported some years ago from Martinique have fruited, one very freely, this is a fine fibreless mango with a yellow skin and of good flavour, but not so good as the Bombay mango."

In the Report for the succeeding year we find there were then planted out at Hope Gardens 20 grafted plants from trees of the noted Bombay mangoes imported by Sir John Peter Grant and sent to Castleton; also the following from Prof. G. Landes, Martinique—2 Julie, 1 Martin.

One of the trees of the Mexican mango ripened fruits. "They were of excellent quality, large, of good appearance and of excellent flavour."

Colonel J. G. Griffith, the owner of Hodge's Pen, near Black River, imported at great expense, grafted plants of the "Alfonse" or "Afooz" mango from India. This Mango is described in the Dictionary of the Economic Products of India, as follows:—"This is the celebrated Bombay mango, a lovely orange colour, with reddish flesh. It is really not a Bombay fruit at all, but probably came originally from Salem. Absurd prices are often paid for this fruit, as much as R60 per 100 being given dealers. Like most mangoes this should never be eaten fresh, but should be gathered ripe from the tree and laid upon a shelf, for a few days to fully mature. Weight 8 to 12 ozs."

The number of varieties now in Jamaica is very large. and nearly every district has its own particular kinds, Next to the imported Alphonse, Bombay, and other kinds, the celebrated No. 11 is prime favourite everywhere. It is a full, fine flavoured mango, but somewhat fibrous.

Although the mango grows freely everywhere, it is not a fruitful tree in every district; in the southern plains, and the low, dry limestone hills it produces enormous crops year after year, and very often two crops a year, the main crop from May to August, and the second crop later in the year, The crop season varies slightly according to locality and altitude, so that it is possible to get mangoes nearly all the year round. In districts where the fruit is plentiful, the natives to a large extent subsist on it during the season, and appear to suffer no ill effects, but on the contrary look well and strong. As already stated, all animals are exceedingly fond of the fruit. Horses will leave a feed of corn to eat mangoes, and when being ridden over mountain roads, horses and mules will stop to pick up a fallen fruit. Cows collect under the trees in the pastures and scramble for the fruits as they drop. In humid districts, and along the northern coast, the tree is not at all fruitful except in very dry years, and in the wet districts like Castleton it rarely fruits. This is probably due to the fact that in such districts the trees are never at rest, but always in a state of vigorous growth; or it may be due to defective pollination; trees in humid localities often flower profusely but fail to set fruit, and this would indicate that the pollen, owing to the excessive humidity, is never in a suitable condition to be carried about by insects or by the wind.

The export trade in mangoes is small, but is capable of enormous expansion. In 1877, the number of fruits exported, was only 600. valued at 15s.; ten years later the number was 93,470, valued at £116 6s.; at the end of the next ten years, 854 packages of this fruit were exported, valued at £207; for the year ending March, 1900, the number was 515 packages, valued at £143 10s.

The fruit is considered by some to be best when picked fresh from the trees, but of the choice East Indian varieties it is said that they should be gathered when full, and laid on a shelf for a few days to mature and ripen The taste for mangoes is readily acquired by Europeans and Americans, and children of Europeans in the tropics eat the fruit with keen relish as soon as they are able to eat anything.

Propagation—The choice varieties are propagated by inarching, and the commoner kinds are grown from seeds. It is a curious fact that the choice, delicate imported varieties are seldom produced quite true from seeds, whilst the No. 11, Black Mango, Kidney Mango, etc., nearly always come true.

Budding has been successful, so far, only to a very limited extent, at the Hope Gardens. Experiments in this direction will be continued to determine several points that at present are not quite clear, i.e., the best time of the year to bud, the age of the stocks and the best variety of stock to use, &c.

The tree is remarkable for its vitality; it is quite a common practice to cut off all the limbs, and leave nothing but the stump of a large tree that is giving too much shade for other crops, and yet, in a year or two it will again have a fine head of branches and foliage.

The following special opinions on the subject of mangoes, have been received:—

From Colonel J. G. E. Griffith, Hodges, Black River.

I am very pleased to place at your disposal any information I pos-

sess in re the Indian Mango, and having served 32 years in India, mostly in the Bombay Presidency, I think I may be able to make it fairly complete.

Since 1884 I have been struggling to introduce the two best kinds of Indian mango into Jamaica, and have made three separate importations; the 1st., doubtful; 2nd., a complete failure; 3rd, eight healthy plants planted out at Hodges, and doing well, out of twelve started from India, two dying and two sickly on voyage to London, the two sickly ones dying out here. The eight planted out at Hodges are healthy and showing good growths. The two kinds I have imported are the famous Mazagon mangoes. (Mazagon is a suburb of the city of Bombay) the "Alphonse" also called by the natives of Bombay "Afoos," and the Pærēē, the latter has a raspberry flavour. You can eat both with a spoon, and there is not the slightest taste of turpentine, neither are they a bit stringy, the stones are small and thin.

My reason for persevering, is, I believe there is money in it, as a single fruit of Pærēē or Alphonse used to fetch in Bombay, on the spot, 6d. and sometimes 1s. in 1886, Europeans, Americans, and Parsees eagerly buying them at those prices and people hundreds of miles up country use to get them by rail for dinner parties and balls, packed in ice This was 15 years ago, and as everything has got dearer in India, Bombay especially, since then, these celebrated mangoes are not likely to have decreased in value. The mango tree flourishes and thrives at Hodges, quite as well as in Mazagon, Bombay, it is a mere question of cultivation, hence my belief that there is money to be made in cultivating these two particular kinds of mango, shipping them to England and America.

Firminger says "the two principal localities in India where mangoes of the finest description are said to be produced are Mazagon at Bombay, and Malda."

Firminger's book bears date of 1864, it may have been so then, but people in Bombay Presidency, and others hundreds of miles north, consider the Mazagon Mango the finest, otherwise they would not trouble to get them up by rail, in ice, all that distance." Still the Malda Mango is an excellent one, but cultivation during the last 35 years, the situation on the harbour, and the soil have combined to put the Alphonse and Pærēē first, such is the consensus of opinion generally in India. They don't thrive everywhere, that is, they don't produce the same excellent fruit excepting in favoured localities and soils; they appreciate the sea air.

Hodges has large Mango Groves: as they are situated on Negro House Common and other spots where the slaves lived, there can be little doubt they were planted by the slaves, indeed tradition says so. Mango trees do so well at Hodges, I am confident the Alphonse and Pærēē will be a success.

I firs imported the Alphonse (or Afooz) into Jamaica in 1886, 12 plants, only two survived, one is at Elim, St. Elizabeth, the other in Hodges Yard; it is doubtful whether the graft has not been knocked off the latter. Neither tree has yet fruited, possibly owing to want of proper cultivation as a grafted mango should fruit in five years. *2nd* importation, 6 Alphonse Plants in 1899, none survived.

3rd Importation, in 1901, 6 Alphonse and 6 Pærēē plants sent from

Mazagon, Bombay last year via England, 8 plants now survive, planted out at Hodges, and doing well. If my memory serves me rightly five are Alphonse and three Pærēē, but I am not certain.

The altitude of Hodges House is some 30 odd feet above sea level.

The plain from Fonthill to Pedro Savannah is more or less the same with rising ground here and there.

The plain from Hodges Wharf on the sea up to the foot of Hodges Mountain land on Louana Hills, is about 1½ to 1¾ miles. Mangoes do far best on the plain.

Mangoes are in season early at Hodges but it depends greatly on the season and the rain. This year the fruit commenced to ripen early in May and the fruit continues for some three months I should put down June as the month for the principal crop on the plains. During last five years, highest temperature in Hodges House 93 degrees, lowest (in front verandah) 59 degrees, mean temperature during day 87 & 88 degrees, at night 72 to 74 degrees.

From Mr. H. W. Griffith, Hodges, Black River.

The names of mangoes known round about Hodges district are:

Turpentine	Greenskin
Milly	Apple
Sweetie	Kidney
Windsor	Robin
Plum	No. 11.

Also one very large mango which weighs up to 2lbs each, but vulgarly known as "John-crow-belly-full." All these mangoes are very stringy. A small place I have on the hills facing the sea, behind Hodges and situated 780 feet above sea level, has one East Indian Mango tree, which bears very large mangoes similar to Hope Gardens East Indian Mango, not in the least bit stringy and a delicious flavour, slightly turpentiny if eaten too close to the skin.

At the Rectory they have a young mango tree, the mangoes much resemble in shape the ones I have on the hills, *i.e.* they have a bump in place of an indentation which the Jamaica mangoes have.

The Rectory mango, I believe, came from Brazil. One important point in mangoes for exportation, I have noticed, and that is, if the East Indian (stringless) mangoes are picked when full, but before they turn yellow, and put on one side to ripen, when cut open and eaten with a spoon, they are found to be slightly stringy, whereas if picked off the trees when ripe, and kept for a day or so (before they go too ripe) they are quite stringless; by this I fancy all mangoes exported will be more or less stringy. The rainfall here for the last twelve years is as follows:—

	Ins.	Pts.		Ins.	Pts.
1890	50	64	1896	39	65
91	49	7	97	67	18
92	55	26	98	43	81
93	62	99	99	67	53
94	63	18	1900	60	6
95	40	8			

The formation of soil here is mostly sand, clay, marl.

From Mr. W. Panton Forbes, Yardly Chase, Southfield

This is one of the best mango districts; bear heavily as a rule, they

begin to ripen in May and go on till September. The droughts in this particular district seem to favour their bearing.

Our altitude is 1,550 feet, and we are ¾ miles from the sea, with table land and good roads to the edge of the cliff.

Local names:—Robin Mango; No. Eleven; Green Skin; Turpentine; Common; Yam; Cashew; Mammee; Black; Kidney (No. 1); Cotton; Beef; Hairy; Kidney (No. 2) Dardy William; Blue.

From Mr. S. A. Shaw, Alligator Pond.

The "Common Mango." In the lowlands here this kind is much preferred, a very delicious mango, round in shape, bright yellow, with rosy cheeks.

2. "Robin." This is rather flat in shape, ripens green, with a shading of reddish brown; a most luscious mango, though rather stringy, very soon after ripening spoils, getting black spots.

3. "No. Eleven." This is generally known, I need give no description.

4. "Kidney." I doubt not so called from the shape, ripens green, fairly agreeable in flavour, not very stringy.

5. "Big Breast." May be the same as "Yam Mango," or "Beef Mango," large size and round, rather mealy and when not quite ripe cuts like a yam; nothing particular to recommend it in flavour.

6 "Turpentine." Somewhat round, ripens green, strongly flavoured of turpentine.

7. "Scratch." Oval in shape, ripens green, reddish brown cheeks, scrapes the tongue and throat; only for pigs.

8. "Green Skin." This I believe is known elsewhere as "Black Mango," rather small in size; there are two descriptions in this district, viz, one ripens green, the other pale yellow, a most delicious mango, very much esteemed. It has little or no string, but soon spoils.

9. "Cashew Mango." Resembling in shape a Cashew nut, and very little larger, black and agreeably flavoured, sold by the quart.

10. "Cow Tongue." A long flat shaped, pale, greenish-yellow; nothing special in flavour.

The approximate altitude for mangoes is 600 feet; over 1,000 feet they do not bear fruit, or very rarely, the temperature I should say about 60 degrees and the rainfall an average (*i.e.* this district) 16 inches for the year. Mangoes are generally in season from May to August or September.

From Dr. James Neish, Old Harbour.

In answer to your inquiries relating to mangoes, I have to say that I think I may include my own inquiries in the locality and send you the result.

ORDER OF MERIT.

List 1.	List 2.
No. 11	Miss Lucy } growing at Dairs, St.
Black Mango	Nelly } Catherine, 500 ft.
Hairy Skin	Pint of Wine, St. Catherine
Kidney	No. 11
Plum Mango (a very small kind sold by measure)	Kidney
Ladies Finger	Hairy Skin. Common over a large area of western St. Catherine, most abundant in St. John
Pint of Wine	

List 3.

Busha's Wife. Growing at Albion Estate St. Thomas. Name comes from the fact that the overseer's wife in former days used to watch the tree to make sure that the fruit was not stolen

No. 11

List 4.

Robin (a mango growing in St. Elizabeth)

No. 11

Black

Beef (St. Catherine)

Nelly (Dairs, St. Catherine)

Stone

List 5.

Hairy Skin

Black

Robin

No. 11

Yam Mango

Plum (sold by the quart at 1½ to 3d.)

I have found an almost universal preference given to the and I have satisfied the curiosity of many of its admirers and consumers by telling them how the name arose. The newly introduced mangoes, as the Bombay from India, have not been cultivated here as yet. The most abundant of all mangoes in this locality is the Hairy Skin.

It seems to grow at all elevations; in the peasants' yard, at the level of Old Harbour, and close to the seaside, and almost at sea level at Old Harbour Bay, and at below Barton's 1,800 feet and under at Marly Hill, 2,016 feet, and at Ballard's Gate, (now corrupted into Bella's Gate) at 2,750 feet. It has thus a wide range and it seems to grow equally well in the red ground or red soil derived from white limestone rock tinged with ferric oxide, and the felspathic soils (richer in potash than the red ground) at Marly Hill, Ballard's Gate and Coco Walk, down to the Bodles pen.

List No. 1 is my own, the others are those of friends who do not give their names My own opinion is that the Department would do well to extend the cultivation of the Nelly, Miss Lucy, Robin, Pint of Wine, and lastly, in this order of enumeration, but first in the estimation of my friend and informant, the Busha's wife So loud are the praises I have heard of this mango, that I feel sure we owe a debt of gratitude to the lady who took such watchful care of the tree and its choice fruit

The season lasts from June to September and early October. It is not uncommon for a tree to bear two and even three crops of fruit in the season. The first crop may grow on a particular side of the tree and be limited to this aspect and division of the branches; the second and third crops are more likely to be produced on those parts of the tree which did not bloom at the period when the first crop was being formed.

The year 1901, must be recorded as a famous year in regard to mangoes. There was an early bloom of very profuse character. The prolonged rains of June and early July have helped on the growth of the fruit, and in the elevated, cultivated lands the growth this season is simply enormous, and the crop has sufficed mainly for the nourishment of a large impoverished population in St. John.

On the 12th of July I made an extensive journey of 22 miles on the main and parochial roads of St. Catherine; mangoes everywhere, mangoes in the hands of children, women and men; head loads, ham-

per loads and cart loads, all mangoes, all got ready for the morrow's market on Saturday. The coachman stopped my vehicle for luncheon under the cool shade of a noble mango tree. Mangoes strewed the roadside at the place all about (we were then some 13 miles distant from Spanish Town, near to the Point Hill Road) and my man helped himself to some really fine and handsome hairy skin, rather than allow them to rot on the ground. In many places, in fact, decayed mangoes were to be seen, a sign of their superabundance.

From Mr. C. W. Treleaven, The Bogue, Balaclava.

I was at Golden Grove Estate in Hanover from Monday and returned yesterday. There are lots of trees (mango) on that estate, but none of them are bearing at present, and very seldom do. The elevation is from about 750 to 1,000 feet. On my way home yesterday I passed Ramble, Knockalva, Barneyside, Woodstock, New Savannah and Newmarket. There were plenty of mango trees with magnificent foliage but not any fruit When I got below Newmarket, (Black River side) the trees began to show a little fruit, and bore heavier as one got farther on, until reaching the lowland where the trees were bearing very heavily indeed. So far as I have seen, places of over or near 1,000 feet, with a large rainfall do not seem so suitable for mangoes as places of the same elevation, but with less rain: the higher parts of St. Elizabeth and Manchester, for instance. Here, at Bogue, we always have a good crop of mangoes, provided we do not get any or very little rain when the blossom is setting, but rain at that time seems fatal. This year, in this district, the mangoes are bearing very heavily. As regards names, except in the case of No. 11 and one or two others, they differ, I fancy, in different localities; the undermentioned are all that I know of, and placed so far as I know, in order of quality.

Ordinary No. 11, Robin Mango, Guinea Mango, sometimes called Jenny, Milk Mango, Sweet Mango, and Hog Mango. There is also an immense mango, which is scarce, and in this district goes by the name of "John Bellyful."

From Hon. Oscar Marescaux, Cherry Garden.

My Mango came from Castleton, and was one of the first inarched from the trees imported from India by Sir John Peter Grant. I was given four varieties, but one of the plants died when quite young, another was cut down during one of my absences from the Island, and the third which has developed into a fine large tree has never borne any fruit, though this year it had one spike of blossoms none of which fructified. The fourth and last is the tree in question, a very handsome one, with branches down to the ground and which bore two distinct crops this year.

It may interest you to know that there is at Cherry Garden besides, numerous No. 11 and other common mangoes, the "Sophy," which bears late in the season (not ripe yet) and is very aromatic, quite distinct from the ordinary sorts, and the "Simon" mango, an early fruiter, without turpentine or filaments, which is much prized; I am sorry to say that the only tree I have is very old and has little vigour. From Martinique I have imported and planted out a dozen "Grafted Mangoes," which are only now coming into bearing.

From Mr. Josepn Shore, Cinnamon Hill, Little River.

This is a very dry locality with only 39 inches average rainfall, and only the hardy kinds of mango thiive here, these being also the coarsest kinds, viz., Black (smallish, covered with black spots, very sweet and free from worms.) Kidney (medium size, reddish yellow, very subject to worms, kidney-shaped) Round-point and Long-point (or stringy mango, the former smaller than the latter, full of fibres yellow colour, the commonest mango about here, generally free from worms.) These are the varieties about here; further inland and in the Queen of Spain's Valley where the rainfall is 50 to 60 inches there are some more kinds such as No. 11 (the best, very seldom found in pastures but mostly in settler's lands and in gardens) Bastard No. 11 (like the former kind in shape, but of inferior quality and subject to worms, blacker in colour) Rosy-cheeked mango, or Nubby mango, (a small very sweet and clean mango, bright red shaded with green.) Mammee mango (large, coarse, of rather nutty flavour.) Sugar Mango (very large, very sweet, rough brownish black skin, found in large groves in many estates and pens.) Saltfish Mango very like the Sugar kind in appearance, very large, with a peculiar fishy odour when cut.) Turpentine (a coarse strong flavoured mango, the twigs from which the fruit is pulled having a strong turpentine smell.

These are all the kinds usually to be found, of course there are some others that are grown in gardens that have fancy names, but seem to be only wild mangoes transformed by cultivation, and of one or other of the sorts named above. The commonest of all is the Stringy or Long Point.

As to the season, I have found from careful observation that in this district mangoes bear once in 18 months. one year in June or July, the next in December, of course the weather conditions may make a difference of a month in bearing, but these are the usual seasons, July and December. Sometimes there may be a crop in July and another in December of the same year, but not from the same trees, and if there is a heavy crop at one time there may be no crop at all or a very small one the next period. I have seen trees bear once in twelve months, but after unusually good weather conditions, the usual period is once in 18 months.

The mango season usually lasts two months, but is variable according to the weather The average altitude of the district is about 350 feet, but the best mangoes grow a little higher, say at 600 to 800 feet, the commoner kinds seeming to thrive better at the lower levels.

Mango trees generally blossom and bear heavily in seasons of great drought, not as a rule giving much of a crop in a seasonable year. Hence the negro saying that a heavy mango blossoming means hard times.

From Mr. Dermot O. Kelly-Lawson, Hampden Estate, Hampden.

No. 11, is our best mango, then in order of merit, come, Black or Sugar mango. Round Point of which there are several sorts, then Long Point, called Hog mango, Turpentine, and a small mango called Guinea Chick.

The Queen of Spain's Valley which is my district has an altitude of about 600 feet. Temperature averages in shade about 82 to 85 Farenheit during the day, 75 to 80 at night and early morning, that is at

this time of year but Dec, Jan. and Feb., I have seen it at 56 in morning early, and 75 during the day. Heavy fogs cover the land at daybreak usually and the dew is heavy.

Rainfall averages about 52 inches per annum, minimum about 40 inches, maximum about 65 inches; May and October are our two seasonable months, but the May rainfall sometimes runs into June and the October rains continue through November and to a lesser extent into Dec. and Jan.

The prevailing idea is, that if a heavy rainfall meets the mango trees when in blossom, no fruit sets and consequently no crop for that year, also that the heavy fogs we have injure the setting fruit buds, I cannot vouch for this, but it is only every *4th* or *5th* year that mangoes bear plentifully in the Queen of Spain's Valley, and it is usually in a very dry year that they do. Number Eleven Mangoes come in first, then Black or Sugar, lastly "Round Point" which by the way is often called Stringy mango.

From Mr. J. O. Mason, Orange Bay.

1st, Number Eleven. This mango is highly esteemed.
2nd, Black Mango otherwise called Greengage, good.
3rd, Mammy otherwise called Yam Mango.
4th, Round or common, also called "Salt fish"
5th, Parrot
6th, Turpentine, acid in flavour.
7th, Long point mango.
8th, Kidney.
9th, Miss Gusket, a large thick skin, coarse in eating: this is what the people in the district call it. Several of these mangoes grow in different parts of the Island, especially on the north-side They grow from "sea level" to one thousand feet. The temperature varies from 75 to 90 degrees.

Mangoes start to blossom in February and to ripen in May, an generally last till August and September.

From Mr. R. H. Elworthy, Fair Prospect, Priestman's River.

We have only two varieties of Mango on this property, the No. 11 and the Common or Stringy The property borders on the sea and runs back into the hills, and they grow from the level to about 200 or 300 feet elevation (here) but from my own experience mangoe grow at almost the highest elevations.

Rainfall here for the last 3 years, averaged 116 inches.

Two other varieties, viz., Kidney and Black mangoes.

From Mr. J. Thompson Palache, Clover, Mandeville.

The varieties are very numerous and have a number of local names.

1st. The No. 11, confined almost entirely to the Porus district of this Parish, and very rarely found in any other part of the Parish, considered the best Mango we have, and in my journeyings all over the island have never found any Number 11 equal to them; the next in approach to the Porus number 11 being those found in the vicinity of Montego Bay.

No. 2. The Robin, principally found in the Prospect district of St. Elizabeth, on the borders of Manchester; greenskin, very luscious, and by some preferred to the No. 11, I have never seen it in any other part of the Island.

No. 3. The Black mango, called by some Greengage, green skin, flesh the colour of Greengage Jam. This mango I have come across in all parts of the Island.

No. 4. Yam Mango, largest variety, pale, yellow flesh, almost stringless, found in all parts of the Island.

No. 5. Turpentine, pale flesh, strong turpentine flavour, found in all parts of the Island and in a very great number of varieties

No. 6. Common Yellow Mango most plentiful in all parts of the Island.

No. 7. Kidney Mango, kidney shaped, delicate, pale yellow flesh, almost stringless, but develops insects very speedily in the ripe state and therefore only regarded as pig feed.

On almost every property in this Parish there is some specific variety with a special name differing from the others, evidently hybrids of the above varieties that would take some time to collect and arrange.

A fact worthy of notice is, that for about 40 years, the mangoes have ceased to bear in the mountains of Manchester, and it is only in the lowlands that we can get mangoes; they do not bear at any elevation above 700 feet. When I was child, they used to bear just as heavily as they now do in the lowlands. I have numbered varieties in the order that I think they are esteemed. The season begins here in May, and lasts until the early part of August, although there are always some early ones to be had in March or April, and some late ones after August. They are always most plentiful in June. A mango we had about Chapelton in Clarendon I never saw anywhere else, called the Plum Mango, it was about the size of a Hog Plum, ripened yellow, and the flesh was egg-coloured, no string, and very small, flat seed and most delicious flavour; I think this variety would be worth looking after and propagating, now that our mangoes are likely to be exported.

From Mr. George Nash, Mandeville.

The mountains of Manchester are not famed for mangoes, only after severe drought can a few be found, and then of poor quality. The trees here are usually cut down and used with other wood in making lime kilns.

A large number of mangoes are sold throughout the Parish, and are brought to market on head or in hampers on donkeys; they come from Porus and from the Savannah districts of St. Elizabeth, and low down on the range of the "Carpenter Mountains."

Mountain mangoes are chiefly fed to pigs, they have rough and thick skins, dark in colour, poor in flavour, and some descriptions are full of worms.

The mango known as the "Robin" grows chiefly on the Savannahs; a few are now coming from Porus. They are large, with a distinct and pleasant rich flavour, they ripen green, at times a yellowish green, and some with a tint of red flushed on each cheek; this mango is not sold in Kingston, so I conclude not grown in St. Andrew.

The "Number Eleven," a few are now coming from the Savannahs, the larger number are from Porus; the description from the Savannahs are sweet to the seed, not so with the Porus description, this becomes acid near the seed, the difference is due to too great moisture,

they have a fine skin, ripen yellow, with a stringy but not unpleasant scent, and if properly cultivated, would be free of strings.

Green Skin Mango ripens green, some with a yellow tint, is free of string, with a distinct and pleasant flavour. The Green Skin in Kingston is known by the name of "Black Mango," it grows in the town and is brought in from the surrounding country; this has a very slight flavour of turpentine. (In fact, I think all descriptions have in a greater or less degree)

There are the Common, Yellow, Kidney, Beef, Yam, Apple, Goose, Turpentine, Burke; all these I consider inferior to those I place in order of merit.

The altitude for mangoes ranges, I should think, from sea level to about 800 feet; it may be higher in some districts, due to location, soil, &c.

From Mr. S. T. Scharschmidt, Hanbury, Shooters Hill.

Order of merit:—

1. Number 11 Mango
2. Robin "
3. Green " stringless
4. Yam " " fleshy and compact, very sweet might do well for shipment.
5. Turpentine "
6. Common or hairy "
7. Kidney or water " poor description

1, 4, 5, 6, & 7 grow about my district, but only bear well in very dry years.

My district is about 1,500 ft. above sea-level with an average rainfall of 100 inches Too much for mangoes.

Mangoes bear well from sea level to 1,000 ft. and at high elevations where the rainfall is not great.

The usual season for mangoes is from 1st May to end July.

Sometime mangoes may be got in warm dry places at about Christmas time, but this is an off crop.

From Mr. Chas. L. A. Rennalls, Mavis Bank.

The names of the mangoes are arranged in order of merit.

	Name.	Season.	
1.	Beef Mango,	July to October,	belongs especially to this district, at least the best specimens of this variety.
2.	No. 11 "	June to August,	Common in nearly all parts of the island.
3.	Hairy "	"	"
4.	Yam "	"	"
5.	Black "	"	"
6.	Long "	"	This is like a small East Indian mango in shape and flavour.

There are many other varieties some of which are not obtainable in large quantities.

Some, however, are abundant, for instance a roundish mango, small sized, of good flavour, commonly called Bastard No. 11.

The Beef mango is by far the best variety grown in this district.

The best specimens of this variety are obtained at an elevation of

from 2,000 to 3,000 feet. The annual mean temperature is about 67 degrees F. Average rainfall from 90 to 100 inches.

From Mr. W. Jekyll, Robertsfield, Port Royal Mountains.

Altitude 1,500-2,500 feet.
Minimum observed indoor temperature 63 degrees F.
Maximum " " 87 " "
Mid June to mid September the thick of the crop
The first spell of heavy wet makes all the mangoes drop.
Headlam esteems mangoes in the following order.

1. Supporter, a single tree at Union, now dead, it was very sweet, no string, plenty juice, red, middling size, middling seed.

2. Cowstone, green to yellow, rather large, delicious smell, hard, not juicy, fine, i.e. not ropy, not fibrous (hereafter fine means flesh without fibre; ropy means flesh with fibre); good flavour, seed moderate size, thick skin.

3. Grandy. Blue (meaning always the colour of the healthy native coffee leaf) small, rather bigger than Black mango, round, very good and sweet, juicy, very thin, flat sed

4. Kidney, red, all sizes, hard skin, long, very sweet, juicy, fine, plenty of meat, seed flat and long.

5. No. 11. Very good in some places, but are liable to maggot.

6. Duckanoo, blue, big enough, round, very sweet, enough juice, fine.

7. Yam, green and red, big and plenty of flesh, kidney shape, hard, fine, fair flavour.

8. Black, blue, round, thin, tender skin, sweet, juicy, the smallest of the mangoes.

9. Parrot, green and red, long, thick skin, very good in some places, others full of maggots, distinguished by its large and conspicuous red nipple or lumps, hard skin, though not as hard as kidney, very sweet, plenty juice, fine, plenty meat, small seed.

10. Hairy, yellow with red cheek on the sunny side, inclining to be round, thin skin, but not tender, like Black mango, good flavour, juicy, moderate size (all kinds appear very variable in respect to size, sometimes Black mangoes are quite big) ropy, would otherwise be excellent, seed rather large.

11. Turpentine, greenish, small, long, juice plenty, sweet, strong smell.

12. Hog, thick at the stem end, tapering suddenly, very juicy and not sweet, fine.

13. Flatside or Beef, red, yellow, greenish, fine (v. definition under Cowstone) coarse flavour, very large, plenty of meat.

Funny is the name given to all other kinds.

Levi Parkes' selection in order of merit, same district:—

1. No. 11.
2. Black.
3. Cowstone.
4. Grandy, no rope, very big and juicy.
5. Hairy and Supporter.
6. Grandfather, not the same as Grandy, only one tree of it on Stewart's land, lining at the top with mine: big tree, big fruit.
7. Parrot.

8. Kidney.
9. Turpentine
10. Yam.
11. Beef or Flatside.

I agree more with Levi's selection than Headlam's placing.
1st class No. 11 and Cowstone (both scarce)
2nd " Hairy, Black Yam (the first two are our commonest kinds)
Lowest " Flatside or Beef (common)

I do not know at all Grandy, Supporter, Turpentine, Hoz, Grandfather, and I am too slightly acquainted with Kidney, Parrot, Duckanoo, to offer an opinion on their merits.

Mangoes are so much better eaten out of doors, that no test of merit is valid unless comparison is made between kinds all eaten out of doors or all eaten indoors.

Then kinds of the same name vary; Levi calls Supporter a rather improved kind of Hairy, which is quite different to Headlam's Supporter. Colour again varies much according to greater or less exposure to sun.

From Mr. L. Tate, Shaftston, Bluefields.

My district is a very poor one for good mangoes; there are a great many varieties grown, but all of the common sorts, and as a rule they are very much troubled by worms. The finest mangoes grown in the district is a variety of Pearl mango, it is of fine size, with a beautiful red and yellow bloom, not very rich, but with thick flesh; the tree is on Mount Edgecombe, the property of the Hon. C. B Vickers, who has also on the same property an East Indian variety grown from a plant procured (as I understand) from His Excellency Sir John Peter Grant, when Governor of the island. Beyond these two varieties and the several varieties that I procured from Hope, some of which have fruited this year for the first time, we have the Common or Bunchy mango, which is a very coarse variety and full of fibre.

The "Dunkeld" or "Greengage" which I think is the same description known in some parts as the "Black mango," a very delicate and delicious little mango, to be enjoyed must be eaten the same day it is taken off the tree.

The Long or Kidney mango of fair size, flesh very rich and creamy but in nine cases out of ten it is wormy, and is consequently not appreciated.

The Bees box mango of fair size with plenty of flesh and fine looking, but absolutely without flavour.

The Mammee or Yam mango.

There are one or two other varieties which I occasionally meet with but do not know their names, but they are not of any special fine quality. The mangoes are produced from the flat by the sea shore quite to the tops of the mountains. This property is about five hundred feet above the level of the sea, and the rainfall is fairly good. I have now growing several varieties of your East Indian mango, grafted plants as well as seedling plants of different varieties that I obtained from different places. The Mango season starts in June and continue for about two and a half months. The rainfall on this property for the past two years is as follows :—

1899	...	134 inches, 42 parts
1900	...	69 " 4 "

From Hon. Chas. B. Vickers, Mt. Edgecombe, Bluefields.

I cannot give any particulars as to the name or origin of this tree. It stands in a guinea grass pasture about a mile from the house, and though mango trees abound on this property and in the neighbourhood, it is the only one of its kind. The negroes call it the "Beef" mango. My late brother William told me, that a Manchester (Ja.) visitor of his said he knew the Mango and called it "Bessy or Sally So and So" giving the name which I have forgotten, I had sent my brother, as usual, some of them.

The tree is rather lofty for a mango and does not spread much. It is getting old and I should very much like to have plants of the kind for myself and the country generally.

The planted seeds do not give the same good mango.

I am equally in the dark as to the introduction of mangoes into Westmoreland. I have a flourishing tree of the Bombay mango, a plant which Sir J. P. Grant sent to my said brother.

The shipping of Mangoes and the Reason for their Absence in the Markets of the United States.

By John W. Harshberger, Ph. D., Philadelphia

The travell·r from temperate countries in first visiting the tropics is naturally much impressed with the large number of new and untried fruits which he meets with on every hand. He tests them all, and after his experimentation has gone on for some time, he generally reaches some conclusion as to those fruits which suit his fancy best. Almost universally, the mango is chosen as one of the most desirable of the 'new' fruits tried. If this is so, why do we not find the mango for sale in the fruit stores, markets, grocery stores and fruit stands of the cities and towns of the United States? It is due, one reasons, if not familiar with the facts, to the imperfect or decayed condition of the mangoes when they reach the northern ports of consumption. Is this so, or is the scarcity of this delicious tropical product due to the lack of energy and business capacity on the part of tropical agriculturists?

This article is written as in part an answer to the above questions, and is based upon actual experiment—the writer having recently visited Haiti and Jamaica on a botanical excursion A little history will be of some help in this discussion. According to the Pomologist of the United States Department of Agriculture (Bulletin 1, Division of Pomology): "No fruit stood higher in the popular esteem of people in parts of South Florida than the Mango. When the disastrous freeze of January, 1886 occurred, every, or almost every tree north of Fort Myers was destroyed. In 1884, 126,968 mangoes were shipped from Jamaica to the United States and brought $900. In their eighth year from seed two Florida trees bore 19,000 fruits. Some of these fruits weighed a pound. Mangoes were shipped to Chicago and brought 60 cents a dozen." So much f·r the history of the first introduction of the mango, as a fruit, into the markets of the United States.

The experiment to be described was conducted by the writer during his return from Port Antonio, Jamaica by steam·r to New York, and thence by rail to his home in Philadelphia. A number of different

sorts of tropical fruits were bought by special arrangements on Monday July 22, 1901. The list of picked fruits, &c., as packed for shipment, comprised plantains, pine apples, oranges, limes, mammee-apples, yams, breadfruits, guava, papaws, sour-sops and manges. In one box, or crate, no especial care was taken in the packing—all of the above named fruits, &c., being nailed up together for transportation. In another box, the mangoes were each wrapped in a piece of newspaper, and carefully packed away in a rather close and partially ventilated case. Two dozen, or more of these fruits in the green state were thus shipped, along with the others to Philadelphia. An inspection of the open, well-ventilated crate, when two days out at sea, revealed the total collapse of the breadfruits and the sour-sops, which had become soft and mushy, and were consequently thrown over board. The other fruits carried well—the mangoes best of all. Those mangoes packed in the open box were all more or less in a mellow condition, while those in the closer box, (wrapped with paper) were firm and sound, although fully ripe. In all cases the fruits of the common sort, 'the turpentine mango,' were found to have changed from the green of unripeness to to the golden orange of the fully ripe mango. Ten days elapsed before the boxes were opened, so that the test made fully establishes the possibillity of shipping mangoes to the larger cities of the American Republic. It should be borne in mind, that the test was a severe one Without a doubt, the mangoes had been collected the Saturday before the writer sailed, July 20th, and kept over Sunday until Monday, when they were bought and packed. The steamer sailed from Jamaica Tuesday afternoon, July 23rd, and reached New York Monday morning, July 29th, where the boxes were expressed to Philadelphia, reaching the home of the writer on Tuesday afternoon, July 30th. The last mango was eaten on Sunday, August 4th, so that fully fifteen days had elapsed from the time of gathering until the date of final consumption.

The writer has no doubt, that a variety of mango can be found, or selected, which will carry even better than the ordinary kinds sold by the negro women in the markets of Jamaica. From informationgleaned from Mr. William Fawcett, Director of the Botanic Gardens, and from Mons. Charles Patin, Consul General of Belgium, to Colombia, the writer believes that the finer races of mango are not known in cultivation in Jamaica, but are only to be found in experimental grounds and in botanic gardens. He knows that several such varieties are now under observation at Hope Gardens near Kingston.

Two elements are, therefore, needed to make the cultivation of mangoes, a profitable undertaking for the people of Jamaica, who sorely need at this time a diversification of their industries. The first thing necessary, as suggested above, is a suitable variety of mango —one that has little fibrous material attached to its seed, one that will carry well and last a long time, and one which is juicy and possesses that delicious turpentiny flavour. The second requisite is a company to push the cultivation in Jamaica, and who will see to its advertisement and general introduction into the markets of the United States.

University of Pensylvania, Philadelphia, Pa.

SOME NEW BANANAS.

NOTES BY A CORRESPONDENT.

The old Martinique is so general a favourite that it is doubtful whether any other variety will take its place, at least in the estimation of the Jamaica public. Nevertheless, when there came from the East reports concerning Bananas of surpassing excellence, it appeared to be worth while to make trial of some of the kinds specially recommended. Suckers of these were put in the Gardens at Hope and are now fruiting, and here is our judgment upon some which have lately come in :—

1. *Cinerea* (*Saharanpur*).—At its best this is a good kind and has a flavour of apple. There is, however, about it a suspicion of staininess as it is called, an astringent acidity which leaves an unpleasant roughness on the tongue. In a finger which is thoroughly ripe this staininess almost, if not quite, disappears, and in this condition it is very good. Its next best stage is the one just before maturity. Over-ripe it is not worth eating, nor is it good cooked, the astringent property giving it a disagreeable taste ;— altogether not likely to be suitable for market purposes. It is much less sweet than Martinique which may recommend it to some people.

2. The pretty little Almeido is unquestionably excellent and should be popular with those who like a dainty fruit. The fingers are only three inches long, rather wide for their length and well shaped. It has a fine flavour, and the small hands look very pretty in the dish.

3. *Kudjo Hudang.*—This has a reddish skin. It seems to be wanting in flavour and the texture is disagreeably soapy, but the fruit was over-ripe and in this condition it is difficult to judge it fairly. Martiniques when too ripe for eating are excellent cooked, but this Kudjo did not prove so. It was still soapy and flavourless.

4. *Red Banana.*—This has peculiarly thick fingers. It was in the best order when tasted and is evidently not a good kind, soapy again in texture and flavourless,— equally poor when roasted.

It should be remembered that opinions expressed, as these are, by reference to a single bunch cannot be entirely relied upon. It strikes us however that Nos. 3 and 4 are certainly not worth growing and that No. 1 is doubtful. No. 2 should be popular if it can be brought to the dining-tables of the rich in other conutries when fruit is scarce and there should be some demand for it here.

5. *Pisang Kelat* from Singapore is a small thick fingered-variety with a speckled skin which in an apple would justify the expectation of fine flavour This however it does not possess. It is best dead-ripe but even then is not very good, and in its earlier stages it has an unpleasant consistency, a kind of flabbiness suggestive of raw meat which is somewhat repulsive. Altogether not a desirable kind if the sample is a fair average one.

6. *M. rubra* does not substantially differ, even if it differs at all, from the Red reported upon above. It has a coarse flavour and the same sliminess of flesh It is not even good roasted.

7. Three fingers of *Frog* or *Tomago* sent by a correspondent look and taste like the Cuban Plantain. Boiled or roasted in the green state it is good and floury. When ripe it is only moderately good and would

not be marketable. It has a curious loose jacket which is also characteristic of the Cuban Plantain. If it is the same thing, and this could only be ascertained by seeing it growing, it is certainly not worth cultivating.

DISEASE OF GINGER IN JAMAICA.

From the Superintendent Hope Gardens, Jamaica, to the Commissioner Imperial Dept. of Agriculture, Barbados.

21st Oct., 1901.

I send by this mail a couple of roots of Ginger affected by the disease known as "black rot." I brought the plants a few days ago from the Ginger district on the borders of the parishes of Trelawny, St. Ann, Manchester and Clarendon.

The disease is well known, and affected plants are easily detected. The symptoms are—sickly-yellow foliage, stem black and decaying. The rhizome of such a plant will also be found to be black and decaying.

The growers carefully dig up affected plants, and the apparently healthy plants next to them in the same row, and destroy them; they also turn up the soil in which the plants were growing, exposing it to the sun, and thus check the spread of the disease. If the disease is neglected, it spreads rapidly, and soon destroys a whole patch of Ginger.

I was told of another disease that sometimes appears in the same district. It is known as "cork rot," and cannot be detected till the crop is ready for gathering. The growth of the plants is not checked in any way, but when the rhizomes are dug they are found to be of cork-like texture, without substance, and of no value.

My informant told me that three years ago, out of a crop which was estimated to yield 50 to 60 barrels of good Ginger he only got a little over 5 barrels of rhizomes that were not diseased, the remainder of the crop having been destroyed by "cork rot."

If the material sent is not sufficient for purposes of examination by Mr. Howard, I would try and get some more from the same district, and perhaps he would prefer to have the plants in a fresh, or moist state, instead of being dried. W. HARRIS.

Imperial Agricultural Department for the West Indies

Barbados, 28 10. 01.

Dear Mr. Harris,

I enclose a Memorandum on the specimens of diseased ginger by Mr. Howard, to whom they were referred for examination.

I trust you will be able to carry out the suggested experiment in which the yields on contiguous acre or half-acre plots in which the rhizomes used for planting have been treated with Bordeaux mixture in the one case, and untreated in the other, are compared and report the results to this Department in due course. It would of course be best if the yields are expressed in pounds or hundred weights per acre, but if this is impracticable, it could be given in barrels.

With kind regards, believe me,

Yours sincerely, D. MORRIS,

Commissioner of Agriculture for the West Indies.

W. Harris, Esq., F.L.S.,

Superintendent of Hope Gardens, Jamaica.

Report on the "Black rot" disease of Ginger from Jamaica.

The rhizomes show dark areas which contain the mycelium of a fungus in which numerous black chlamydospores are produced, frequently in chains. I have placed some of the material in a moist chamber in the hope of getting some more definite spore formation. The mode of formation of the chlamydospores resembles that seen in Wakker's *Allantospora radiicola* which causes a root disease of the sugar cane in Java, and in other fungi which attack plants underground

It is impossible to say whether the fungus in the old rhizomes is the cause of the disease or not. A more definite opinion could be given if specimen of the roots and rhizomes of plants in which this disease is just showing itself could be examined. It is hoped that it will be possible to collect and forward such specimens which should be placed in methylated spirit as soon as the plants are lifted

The fungoid diseases of Ginger do not seem to have been investigated A wilting disease of Ginger occurs here and in St Lucia but "black-rot" and "cork-rot" do not seem to be common. I hope Mr. Harris will be able to send specimens of "cork-rot" especially as the damage done by this disease appears to be so considerable.

The measures taken by the cultivators in Jamaica to prevent the spread of 'black rot' seem to be very intelligent. In addition to these it might be useful to treat the affected soil with lime or with a light dressing of sulphate of iron and when the diseased patch is large to separate it before treatment, from the rest of the field by means of a shallow trench as it would seem that disease spreads under ground.

It would also be desirable if an experiment were made preferably on a field in which 'black rot' has appeared, in which the rhizomes used for planting were washed with water and then steeped for half-an-hour in Bordeaux mixture. The resulting crop and its freedom from disease should be compared with that from an equal area, say half an acre, in which the rhizomes have been untreated. The results of such an experiment would be of great interest and value to this Department.

The very greatest care should be taken *not to plant* any rhizomes which show traces of disease or those from diseased fields. Mr. Cradwick might refer to these points in his lectures to the people.

A. Howard, 28. 10. '01.

Imperial Department of Agriculture for the West Indies.

Instructions for collecting and forwarding specimens of Plants attacked by Fungoid Diseases.

1. Specimens of plants attacked by fungoid pests are constantly being received by the Department for examination and report. Much labour and time is often wasted over these for want of knowledge on the part of the senders as to what should be sent and how it should be packed. This circular is issued with the object of giving information on these points.

2. When specimens of moist vegetable matter are packed in boxes or sent in envelopes they speedily become covered with saprophytic growths which frequently obscure all traces of the original cause of disease and render the specimens worthless. This is especially the case

when the material has been collected some days before the closing of the mails for Barbados.

3. *Fresh specimens of diseased plants* should in every case be placed in methylated spirit, high wines, or rum, immediately after collection and forwarded in a bottle or corked tube. When leaves, buds or twigs are attacked, the specimens should show as many stages of the disease as possible and in all cases a few healthy specimens should also be sent. If these latter are tied up in an envelope and labelled in pencil they can be sent in the same bottle as the diseased material. When fruits, stems or roots are attacked, diseased pieces showing all stages should be cut out and placed in spirit as before, In this case also a healthy piece, properly indicated, should be sent.

4. *Specimens of bark wood and large fungus fructifications* which are *dry* should be wrapped in soft paper and sent in a ventilated package. When it is considered desirable to send very large specimens such as portions of branches, stems, roots of trees or whole cacao pods these should be collected as late as possible before the mail steamer leaves, and sent in a well ventilated case.

5. Full notes should be sent giving details of the time of appearance of the disease, the locality, the damage done, the part attacked and also the date when the specimens were collected.

All specimens and correspondence intended for the Head Office, should be addressed :—

THE COMMISSIONER,
Imperial Department of Agriculture for the West Indies,
Barbados.

NATHANIEL WILSON.

By F. WILSON.

Born in Scotland on 18th April, 1809.—Died at his residence, Spring Plain, Clarendon, Jamaica, on 2nd May, 1874.

Appointed from the Royal Botanical Gardens, Kew, as Island Botanist, Jamaica, about February. 1846.

Prior to the year 1841, and to the Rev. Thomas Wharton taking charge of the Botanic Gardens at Bath, there were five or six acres in cultivation, containing only 174 plants, some of which were indigenous

The Gardens were then under the control and management of a Board of Directors of the Bath of St. Thomas the Apostle.

For a number of years the Gardens suffered under great and various disadvantages, many of the members of the Board of Directors (neither knowing anything nor caring for Botany) not taking any interest in the Institution. Then again, no funds were provided for paying labourers employed in the Garden. At times hogs would trespass and make havoc of the plants and Garden generally; but for the untiring energy and zeal of my father, this Institution would in all probability have come to an end.

In consequence of the want of space, and the overcrowding of plants at the Botanic Gardens at Bath, several valuable plants died. The Gardens also suffered from the periodic overflowing of the Plantain Garden River (or Sulphur River), notably in 1858, when the greater portion of the Gardens was destroyed in this way.

As far back as 1856, my father made strong and repeated representations to the Governor, and Executive Committee of the House of Assembly for a better and more adequate site for a Botanical Garden worthy of the Island; as a result of these appeals, a site was selected by Mr. Parry, (I believe), at Castleton, and my father was requested, in September, 1859, to visit and report on the general suitableness of the place.

The report was favourable as to soil and climate. Clearing the land, &c., commenced about the end of 1860, or early in 1861. In 1862, some doubt appears to have arisen as to the desirability of the spot selected in view of its distance from Kingston A Committee was appointed "to take evidence on oath, and enquire into the expediency of continuing the formation of a Botanic Garden on the site recently selected."

After evidence had been taken, the Committee appears to have been satisfied, and the work was proceeded with.

An Estimate of the probable expense of the formation and completion of the Garden, including a Nursery for supplying the Island with plants, was sought and obtained from my father.

The total Estimate amounted to £2510 15s. 4d., plus some items, the cost of which he could not very well estimate.

In 1860, the British Government, acting on the advice of His Grace the Duke of Manchester, instructed the Royal Botanic Gardens at Kew to obtain plants and seeds of the Cinchona from Ecuador in order to establish a Quinine Plantation in Jamaica.

The plants and seeds duly arrived, and my father was successful in growing them, first at Bath and then at Cold Spring; this experiment* he reported as having succeeded beyond his expectations.

In 1862, the Cinchona Plantation was established at Mount Essex. Three acres were first established with Cinchona in a healthy and thriving condition, consisting of three distinct species, viz:—C. succirubra, C. nitida, and C. micrantha. This was the first step to establishing the Plantation.

In July 1862, Mr. Robert Thomson was employed as Assistant Botanist.

Great attention was given by my father to textile and economic plants, and a great number of them were introduced into the Island during his tenure of office as Island Botanist. Among the fibrous plants he introduced were:—Boehmeria nivea, or Chinese Grass Cloth, various species of Sansaviera or Bow String Hemp of India, Corchorus olitorius or Jute Fibre of India, Musa textilis, which produces the Manila Hemp,—this latter he strongly advocated being given a fair trial in the Island on account of the diversity of its uses: he had "but little hesitation in saying that a branch of industry more inexpensive, profitable, and better suited to the country and habits of the people does not exist than the cultivation of fibrous plants which are a source of wealth to other nations, and surely merit a fair trial here where nature leaves but little to do in the way of maturing the plants."

* Experiments were made at places of different altitudes, Cold Spring being one of them.

I cannot however find that this plant was given a fair trial. It was my father's opinion that the cultivation of textile plants was one of great importance, and "second only to the cultivation of the Sugar Cane;" he also believed that textile plants were destined at no very distant period to add materially to the permanent prosperity os the Island.

The undermentioned Medals were gained by my father for exhibits he prepared and sent to the various International Exhibitions of the world:—

1. Silver Medal, for an exhibit of Shrubby Calceolarias at the Horticultural Society of Arts, London, on May 13, 1837.
2. Silver Medal for Nectarines at the Horticultural Society, London, 11th July, 1837.
3. Silver Medal for Fibres, London Exhibition, February, 1862.
4. Bronze Medal for Fibres and Basts, London Exhibition, 1862.
5. Silver Medal Ditto Dublin, 1865.
6. Bronze Medal Ditto Dublin, 1865.
7. Silver Medal Ditto International Exhibition, Erfurt, Prussia, August, 1865.

Copies of the Annual Botanical Reports by my father from 1856 to 1866, inclusive, in manuscript form, are in my possession.

The Office of Island Botanist was abolished on the 1st of October, 1867, when my father retired from the Public Service.

26th October, 1901.

FUMIGATION OF IMPORTED PLANTS.

L. S.

A. W. L. Hemming.

By His Excellency Sir Augustus William Lawson Hemming, Knight Grand Cross of the most Distinguished Order of Saint Michael and Saint George, Captain-General and Governor-in-Chief in and over the Island of Jamaica, and its Dependencies.

A PROCLAMATION.

WHEREAS by a Proclamation dated the seventh day of September, and made under the authority of Section 1 of Law 4 of 1884, (The Seeds and Plants Importation Law 1884,) it was among other things proclaimed and ordered that immediately on the importation into this island of any plants, cuttings, buds or grafts, and of any goods, packages, coverings or things in which such plants, cuttings, buds or grafts, hereinafter referred to under the general term of "proclaimed articles" might be packed" they should be subjected to a thorough process of fumigation to be hereafter decided upon.

And whereas the Governor in Privy Council has since decided upon adopting the process of fumigation hereinafter set forth for the purpose of completely destroying all animal or vegetable parasites which

may have been imported on or along with the said proclaimed articles:

Now, therefore, I do hereby proclaim and order that the importation into this Island of all "proclaimed articles" shall be subject to the following conditions:—

All proclaimed articles shall be fumigated, and the work of fumigation shall be carried out by the staff of the Government Laboratory —a fumigatory box shall be employed for small operations. and a fumigatory chamber at the wharf for large. For ordinary purposes the dose of cyanide to be vaporised shall be one ounce for every 300 feet of cubic space and the exposure shall be one hour. For the more delicate plants half the above dose of cyanide shall be used and the exposure shall be half an hour only. Plants in Wardian cases shall be fumigated while still in the case. The Island and Agricultural Chemist shall be the authority to decide in any question connected with the fumigation of proclaimed articles which involves the exercise of any discretion.

Given under my hand and the Broad Seal of this Island, at King's House, this fifteenth day of October, in the First year of His Majesty's Reign, Annoque Domini, 1901.

By Command,

SYDNEY OLIVIER, Colonial Secretary.

ADDITIONS AND CONTRIBUTIONS TO THE DEPARTMENT.

LIBRARY (Serials).

EUROPE.

British Isles.

Annals of Botany, Sept., 1901. Vol. XV. [Purchased.]
Botanical Magazine, Sept., Oct. [Purchased.]
British Museum Annual Returns, 1900-1901. [Principal Librarian.]
Bulletin Kew Gardens, Nov.-Dec., 1900. Jan.-Mar. 1901, and App. April-June, July-Sept. [Director.]
Chemist and Druggist, Aug. 24, 31, Sept. 7, 14, 21, 28. Oct. 5, 12, 19, 26, [Editor.]
Diplomatic and Consular Reports, Aug. 1901. [Col. Sec.]
Garden, Aug. 24, 31. Sept. 7, 14, 21, 28. Oct. 5, 12, 19, 26. [Purchased.]
Gardeners' Chronicle, Aug. 24, 31. Sept. 7, 14, 21, 28. Oct. 5, 12, 19, 26, [Purchased.]
Hooker's Icones Plantarum Vol. VIII Part I. Sept. 1901. [Bentham Trustees through Kew.]
International Sugar Journal, Sept., Oct [Editor.]
Journal, Board of Agriculture, England. [Sec. Board of Agri.]
Journal of Botany, Sept., Oct. [Purchased.]
Nature, Aug. 22, 29. Sept. 5, 12. 19, 26. Oct. 3, 10, 17, 24. [Purchased.]
Pharmaceutical Journal, Sept. 7, 14, 21, 28. Oct. 5, 12, 19, 26.
Rothamstead Reports for 1901, By Sir J. H. Gilbert.
" Plans and Summary Tables arranged for reference in the field. [Committee.]
W. Indian and Com. Advertiser. Sept., Oct. [Editor.]

France.

Sucrerie Indigène et Coloniale, Aug. 27. Sept., 3, 10, 17, 24. Oct. 1, 8, 15, 22. [Editor.]

Germany.

Tropenpflanzer. Sep., Oct. Nos. 4 and 10. [Editor.]

Bericht uber den Botanischen Garten und des Museum zu Berlin um Rechanungsjahr, 1900.

Belgium.

Bulletin de la Société d'Etudes Coloniales,Feb., March, 1900.

Switzerland

Bulletin de l'Herbier Boissier Nos. 9, & 10. [Conservateur.]

Asia.

India.

Planting Opinion, Aug. 3, 10, 17; Sep. 7, 14, 21, 28. [Editor.]

Agricultural Ledger (Calcutta) Nos. 1, 2, 3, 4, 5, 6, 7, 13, 1901.

" " " No. 7, 1892-1894. [Lt. Gov. Bengal.]

Report on Gov. Bet. Gard., Saharanpur & Arnigadh, 1901. [Curator.]

Report on Gov. Hort. Gard., Lucknow, 1901. [Curator.]

Madras.

Administration Report of the Govt. Bot. Gardens & Parks, Nilgiris, 1900-1901. [Secretary.]

Department of Land Records & Agriculture: Bulletin No. 36 (Sugar Cane Pest in Madras) 37 (The Ground-nut, Arachis Hypogæa) 38 (The Ground-nut crops) 39 (The Sugar cane) 40 (The Seed Drill) 41 (The Ground-nut crop) 42 (Native beliefs regarding hair marks on horses and cattle) 45 (A Tea-eel worm disease in South India.)

North Western Provinces & Oudh.

Bulletin 12 (Irrigation Wells in the Western Portion of the North-west Provinces of India) 13 (Cultivation of Sugar-beet in North India) 14 (Different Systems of housing Cattle and Conserving Manure.)

Ceylon

Times of Ceylon. Aug. 9, 15, 21. Sept. 4, 12, 19, 25. Oct. 3. [Editor.]

Japan.

Bulletin, Coll. of Agriculture, Vol. IV, No. 4.

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SEEDS.

From Botanic Gardens, Sydney—
Banksia ericæfolia; B. spinulosa; B. collina.
B. marginate; B. paludosa; B. latifolia; B. serrata.
Conospermum ericifolium; C. taxifolium.
Grevillea Banksii; G. robusta; G. sericea;
G. linearis; G. Caleyi; G. buxifolia.
Hakea propinqua; H. leucoptera; H. gibbosa;

H. pugioniformis.
Isopogon anemonefolius; I anethifolius.
Lomatia ilicifolia.
Macadamia ternifolia.
Persoonia pinifolia; P. linearis; P. Coamæpeuce;
P. ferruginea.
Petrophila sessilis; P. pulchella.
Stenocarpus sinuatus; S. salignus
Telopea speciosissima.

From Supt. Bot. Garden, Seebpur.
Sindora Wallichii, var. siamensis

From Dr. P. Preuss, Dir. Bot. Gard., German Cameroons, W. Africa—
Coula edulis.

From Roy. Botanic Gardens, Kew—
Mimusops Schimperi.

From Messrs. Reasoner Bros., Florida—
Quercus virens; Serenoa serrulata; Desmodium tortuosum.
Sabal Palmetto; Peccan Nuts.

From Messrs. Herb. & Wulle, Naples—
Bellis perennis fl. pleno; Dianthus Margaritæ fl. pl.
Gloxinia hybrida grandiflora; Helianthus cucumerifolius;
Heliotropium regala; Impatiens Sultani; Phlox Drummondi atropurpurea P. D. grandiflora vi lacea P. D. nana compacta nivea; P. D. rosea; Reseda odorato ameliorata; R. O. Gabriole.

From Senor Pittier, Director Institute Fisico- Geografico, Costa Rica—
Castilloa Tunu.

PLANTS.

From J. Thompson, Esq., Spanish Town—
Potato Slips.

From Dr Plaxton, Kingston—
1 Dendrobium Pierardi; 1 D. fimbriatum oculatum; 1 D. nobile;
1 Epidendrum nocturnum: 2 E. fragrans; 1 E. anceps; 3 E. cochleatum;
9 Stanhopea spp.; 1 Cypripedium sp.; 1 Coelogyne flaccida;
1 Cattleya sp. 1 Peristeria elata; 1 Maxillaria crassifolia;
1 Brassia maculata; 1 Laelia Digbyana; 1 Brassavola cordata;
1 Aerides sp.; 1 Oncidium Papilio; 1 O. ampliatum majus; 1 O. luridum

From Robt. Thomson, Maryfield—
4 Passiflora ligularis.

From U. S. Dept. Agriculture—
Persimmons: 10 Plants of the following varieties:—
Costata, Hachiya, Hyakume, Okame, Tane-nashi, Tsuru, Yeddo-ichi, Yemon, Zengi.

From Harvard Bot. Gar., Cambridge, Mass. U.S.A.—
Acalypha Godseffiana; Achimenes mixed; Anthuriums;
Calathea Vandenheckei; Centropogon Lucyanus; Cypripedium Lawrenceanum; Cyp. venustum; Davallia Mooreana; Dendrobium Aphrodite;
D. cretaceum; D. tortile; Dracaema Sanderiana; Nepenthes intermedia;
N. picturata; Oxalis sensitiva; Phalænopsis Luddemaniana; Pothos scandens; Tillandsia zebrina; and 5 Plants without names.

From Hon. Oscar Marescaux, Cherry Garden—
Cuttings of Passiflora vitifolia.

From Herb & Wulle, Naples—
Bulbs of Crinum amabile superbum; C. lineare; C. longifolium (capense), Lycoris aurea

From Dr. Grabham, Kingston—
Opuntia Tuna. Good Varieties from Madeira.

HERBARIUM.

From R. Botanic Gardens Herbarium, Trinidad—
7 Specimens (Mounted).

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